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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 635598

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Jim G. Field, Data Assessment and Interpretation, R2-12, 376-3753	[] Yes [X] No	03/23/98
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-S-106	241-S-106	N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	HNF-SD-WM-ER-714, Rev. 0	N/A	N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change 13b. Design Baseline Document? [] Yes [X] No

The document has been totally revised to include the results of recent sampling to address technical issues associated with the waste, and to update the best basis standard inventory.

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Changes required to incorporate new sampling data.

15. Distribution (include name, MSIN, and no. of copies)

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ENGINEERING CHANGE NOTICE

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16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J.G. Field	J. G. Field	4/15/98	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall	4/16/98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
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R.J. Cash	for 4/15/98 R J Cash	4/15/98	DEPARTMENT OF ENERGY		
			Signature or a Control Number that tracks the Approval Signature		
J.G. Kristofzski	for [signature]	4/17/98	ADDITIONAL		

Tank Characterization Report for Single-Shell Tank 241-S-106

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U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-S-106. This report supports the requirements of the Tri-Party Agreement Milestone M-44-15B.

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Tank Characterization Report for Single-Shell Tank 241-S-106

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ANOVA	analysis of variance
Btu/hr	British thermal units per hour
Ci	curie
Ci/L	curies per liter
CI	confidence interval
cm	centimeter
cm^3	cubic centimeter
CWR	REDOX cladding waste
CWR1	REDOX cladding waste (1952-1960)
DQO	data quality objective
DSC	differential scanning calorimetry
ft	feet
ft^3	cubic feet
GEA	gamma energy analysis
g	gram
g/cc	grams per cubic centimeter
g/g	grams per gram
g/gal	grams per gallon
g/L	grams per liter
g/mL	grams per milliliter
grav. % water	gravimetric percent water
HDW	Hanford defined waste
HTCE	historical tank content estimate
IC	ion chromatography
ICP	inductively coupled plasma
in.	inch
J/g	joules per gram
kg	kilogram
kg^3	cubic kilograms
kgal	kilogallon
kg/L	kilograms per liter
kL	kiloliter
kW	kilowatt
L	liter
LCS	laboratory control standard
LFL	lower flammability limit
LL	lower limit
m	meter
m^2	square meters

LIST OF TERMS (Continued)

m^3	cubic meters
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mL	milliliter
M	moles per liter
mm	millimeters
mol%	mole percent
n/a	not applicable
N/A	not available
N/D	not decided
n/r	not reported
PHMC	Project Hanford Management Contractor
ppm	parts per million
ppmv	parts per million by volume
QC	quality control
R1	REDOX high-level waste (1952-1957)
REDOX	reduction-oxidation
REML	restricted maximum likelihood estimation
RGS	retained gas sampler
RPD	relative percent difference
RSST	Reactive systems screening tool
SACS	Surveillance Analysis Computer System
SMM	supernatant mixing model
SMMS1	saltcake waste from 242-S Evaporator (1973-1976)
SpG	specific gravity
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TLM	tank layer model
TOC	total organic carbon
TSAP	tank sampling and analysis plan
TWRS	Tank Waste Remediation System
UL	upper limit
USQ	unreviewed safety question
W	watt
W/Ci	watts per curie
WSTRS	waste status and transaction record summary
wt%	weight percent
%	percent
°C	degrees Celsius
°F	degrees Fahrenheit

LIST OF TERMS (Continued)

μCi/g	microcuries per gram
μCi/mL	microcuries per milliliter
μCi/L	microcuries per liter
μeq/g	microequivalents per gram
μg C/g	micrograms of carbon per gram
μg C/mL	micrograms baron per milliliter
μg/g	micrograms per gram
μmol/L	micromoles per liter
μg/mL	micrograms per milliliter

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1.0 INTRODUCTION

A major function of the Tank Waste Remediation System (TWRS) is to characterize waste in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis and other available information about a tank are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for single-shell tank 241-S-106. The objectives of this report are 1) to use characterization data in response to technical issues associated with tank 241-S-106 waste and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. Section 2.0 summarizes the response to technical issues, Section 3.0 shows the best-basis inventory estimate, Section 4.0 makes recommendations about the safety status of the tank and additional sampling needs. The appendices contain supporting data and information. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1997), Milestone M-44-15B, change request M-44-97-03, to "issue characterization deliverables consistent with the Waste Information Requirements Document developed for 1998."

1.1 SCOPE

The characterization information in this report originated from sample analyses and known historical sources. The results of recent sample events will be used to fulfill the requirements of the data quality objectives (DQOs) and memoranda of understanding specified in Brown et al. (1997) for this tank. Other information can be used to support conclusions derived from these results. Appendix A contains historical information for tank 241-S-106 including surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model. Appendix B summarizes sampling events (see Table 1-1), sample data obtained before 1989, and sampling results. Appendix C reports the statistical analysis and numerical manipulation of data used in issue resolution. Appendix D contains the evaluation to establish the best basis for the inventory estimate and the statistical analysis performed for this evaluation. Appendix E is a bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-S-106 and its respective waste types. The reports listed in Appendix E are available in the Lockheed Martin Hanford Corp. Tank Characterization and Safety Resource Center.

Table 1-1. Summary of Recent Sampling.

Sample/Date[1]	Phase	Location	Segmentation	% Recovery
Push core (2/12 to 2/21/97)	Solid/liquid	Riser 8	10 segments, upper half and lower half	77 to 100%
Push core (3/3 to 3/17/97)	Solid/liquid	Riser 7	6 of 10 segments, upper half and lower half	88 to 100%
Push core (3/19 to 3/21/97)	Solid/liquid	Riser 14	2 of 10 segments, upper half and lower half, no analyses	0 to 20%
Vapor samples and combustible gas test (6/13/96)	Gas	Tank headspace Riser 11 and Riser 6, 6.1 m (20 ft) below top of riser	n/a	n/a

Notes:

n/a = not applicable

[1]Dates are in the mm/dd/yy or mm/yy format.

1.2 TANK BACKGROUND

Tank 241-S-106 was filled with waste from the reduction-oxidation (REDOX) facility from the second quarter of 1953 until the third quarter of 1953. REDOX cladding waste (CWR) was transferred to tank 241-S-103 in 1955. From 1973 to 1975, tank 241-S-106 received evaporator bottoms waste from the 242-S Evaporator via tank 241-S-102. The tank was removed from service in 1976 and was partially isolated in 1982. A liquid observation well was installed in December 1980, and a jet pump was installed and activated in the fourth quarter of 1983. From 1983 to 1984, 378 kL (99.8 kgal) of liquid was pumped from the tank. A gradual increase in the surface level of the waste in tank 241-S-106 has been noted from 1989 through 1997. Tank samples and surface-level measurements indicate that the waste level in the tank is not uniform and the surface-level increase is likely a result of gas generation in liquids in the top central portion of the tank. The tank perimeter appears to have a hard (impenetrable) crust.

Table 1-2 summarizes the description of tank 241-S-106. The tank has an operating capacity of 2,870 kL (758 kgal) and presently contains an estimated 1,813 kL (479 kgal) of noncomplexed waste (Hanlon 1998). The tank is not on the Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-S-106.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1950-1951
In service	1952
Diameter	22.9 m (75.0 ft)
Operating depth	7 m (23 ft)
Capacity	2,870 kL (758 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Noncomplexed
Total waste volume[1]	1,813 kL (479 kgal)
Supernatant volume[2]	201 kL (53 kgal)
Saltcake volume[2]	1,612 kL (426 kgal)
Sludge volume[2]	0 kL (0 kgal)
Drainable interstitial liquid volume[2]	0 kL (0 kgal)
Waste surface level (11/30/97)[3]	461 cm (181.5 in.)
Temperature (1/97 to 12/97)	16.4 °C (61.5 °F) to 26.6 °C (79.9 °F)
Integrity	Sound
Watch List	None
Flammable gas facility group	2
SAMPLING DATE	
Vapor samples and combustible gas test	June 1996
Push core samples	February/March 1997
SERVICE STATUS	
Declared inactive	1976
Partial interim isolation	1982
Interim stabilization/intrusion prevention	Not completed

Notes:

[1]Waste volume is estimated from surface-level measurements.

[2]Appendix D.

[3]Dates are in the mm/dd/yy or mm/yy format.

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2.0 RESPONSE TO TECHNICAL ISSUES

The following technical issues have been identified for tank 241-S-106 (Brown et al. 1997).

- **Safety screening**: Does the waste pose or contribute to any recognized potential safety problems?
- **Flammable gas**: Does a possibility exist for releasing flammable gases into the headspace of the tank or releasing chemical or radioactive materials into the environment?
- **Organic complexants**: Does the possibility exist for a point source ignition in the waste followed by a propagation of the reaction in the solid/liquid phase of the waste?
- **Hazardous vapor screening**: Do hazardous storage conditions exist associated with gases and vapors in the tank?
- **Organic solvents**: Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?
- **Historical model**: Does the waste inventory generated by a model based on process knowledge and historical information (Agnew et al. 1997) represent the current tank waste inventory?

The sampling and analysis plan (SAP) (Buckley 1997) provides the types of sampling and analysis used to address the above issues. Data from the analysis of push core samples and headspace measurements, along with available historical information, provided the means to respond to the technical issues. Sections 2.1 through 2.7 present the responses. Data from the June 1996 vapor sample provided the means to address the vapor screening issue. See Appendix B for sample and analysis data for tank 241-S-106.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-S-106 for potential safety problems are documented in *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). These potential safety problems are exothermic conditions in the waste, flammable gases in the waste and/or tank headspace, and criticality conditions in the waste. Each condition is addressed separately below. Only one full core (core 183) was obtained. Core 184, riser 7, recovered only 6 of 10 segments because the push-core sampler could not penetrate beyond segment 6. Only 2 of 10 segments were recovered in a second attempt (core 187, riser 14). Consequently, the safety screening DQO requirement to analyze two complete cores was not met.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure there are not sufficient exothermic constituents (organic or ferrocyanide) in tank 241-S-106 to pose a safety hazard. Because of this requirement, energetics in tank 241-S-106 waste were evaluated. The safety screening DQO required that the waste sample profile be tested for energetics every 24 cm (9.5 in.) to determine whether the energetics exceeded the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry weight basis. Results obtained using differential scanning calorimetry (DSC) indicated six samples exceeded the notification limit with exotherms, on a dry weight basis, ranging from 486 J/g to 1,688 J/g (see Appendix B). Because of high relative percent differences (RPDs), DSC analyses were rerun for two of the samples, but the rerun still exceeded the notification limits. However, the high DSC values were greater than total organic carbon (TOC) energy equivalent calculations (Table 2-1), and DSC results were suspect (Esch 1997). In addition, the water content of the samples was well above 17 percent.

As a result, it was concluded that a propogating reaction is highly unlikely.

Table 2-1. Tank 241-S-106 Energetics by Differential Scanning Calorimetry and Energy Equivalence by Total Organic Carbon.

Sample Location	DSC (Dry) Result J/g	DSC (Dry) Dup. J/g	Moisture %	TOC Dry (wt%)	TOC Energy Equivalent[1] (J/g)
183:1 Drainable liquid	1,688	557	54.0	0.496[2]	132
183:3 Drainable liquid	1,094	1,197	55.6	0.471[2]	126
183:5 Drainable liquid Rerun	311 387	876 683	52.7	0.499[2]	133
183:7 Drainable liquid Rerun	188 848	486 740	53.5	0.353[2]	94.1
183:7 solid	191	523	29.0	0.158[3]	42.1
183:4 solid	1,571	246	51.4	0.276[3]	73.6

Notes:

Dup. = duplicate
wt% = weight percent

[1]Conversion value used: 1,200 Joules per 4.5 grams = 1 TOC dry wt% (based on sodium acetate average energetics standard).
[2]TOC by furnace oxidation divided by (1- Moisture)
[3]TOC by sulfate divided by (1- Moisture)

2.1.2 Flammable Gas

Headspace measurements were taken before obtaining the February/March 1997 push core samples. The maximum flammable gas level detected was less than 1 percent. This is below the safety screening limit of 25 percent of the lower flammability limit (LFL). June 1996 vapor samples also showed a low LFL. Data for the combustible gas headspace gas tests (sniff tests) and the June 1996 vapor samples are presented in Appendix B.

2.1.3 Criticality

The safety screening DQO threshold for criticality, based on the total alpha activity, is 1 g/L. Because total alpha activity is measured in μCi/mL instead of g/L, the 1 g/L limit is converted into units of μCi/mL by assuming that all alpha decay originates from ^{239}Pu. The safety threshold limit is 1 g ^{239}Pu per liter of waste. Assuming that all alpha is from ^{239}Pu, for a maximum solids density of 1.92, this limit corresponds to 32.0 μCi/g of total alpha for solids. The maximum total alpha activity dry weight result was 0.0359 μCi/g (core 183, segment 9, lower half). The maximum upper limit (UL) to a 95 percent confidence interval on the mean was 0.0757 μCi/g (core 184, segment 6, lower half), indicating that the potential for a criticality event is extremely low. Therefore, criticality is not a concern for this tank. Appendix C contains the method used to calculate confidence limits.

2.2 FLAMMABLE GAS DATA QUALITY OBJECTIVE

The flammable gas DQO has been extended to apply to all tanks (Bauer and Jackson 1997). Analyses and evaluations will change according to program needs until this issue is resolved. The unreviewed safety question (USQ) for flammable gas safety issues is expected to be closed in FY 1998 and final resolution of the flammable gas data quality objective is expected to be completed by September 30, 2001 (Johnson 1997). These dates are consistent with milestone M-40-09 and M-40-00 (Ecology et al. 1997) to close out the USQ for watchlist tanks and to close out all flammable gas issues for high priority tanks.

Retained gas sampler (RGS) samples were taken and analyzed to address flammable gas issues (Bauer and Jackson 1997). The results of RGS testing are reported in (Mahoney et al. 1997), and summarized in Appendix B of this document.

A gradual increase of approximately 50 cm (19.7 in.) has been observed in tank surface-level measurements between 1989 and December 1997. This increase is attributed to the retained gases in the tank. Sample results indicate the waste surface level is not uniform, the waste has a thick, dry perimeter crust, and supernatant is confined to the top few segments in the central portion of the tank (Mahoney et al. 1997).

Retained gas sampler samples were requested from riser 7, segments 3, 5 and 8; riser 8, segments 2, 6 and 10; and riser 14, segments 2, 8 and 13. No RGS samples were obtained from riser 14 or segment 8 of riser 7 because the waste was too hard. No RGS samples were obtained from the upper liquid layer (segments 1 and 2) because of sampler failure.

Retained gas samples obtained in the nonconvective solids layer indicated that 160 $\pm$ 80 m^3 (5,650 $\pm$ 2,820 ft^3) or 10 percent by volume of the solids are filled with gas. The estimated gas volume from the barometric pressure evaluation was 410 $\pm$ 30 m^3 (14,500 $\pm$ 1060 ft^3) or 26 percent by volume. The retained gases consisted of 24 percent nitrogen, 63 percent hydrogen, 11 percent nitrous oxide; and smaller amounts of ammonia, methane, and other hydrocarbons. The ammonia was dissolved in the drainable liquids.

2.3 ORGANIC COMPLEXANTS

The data requirements to support the issue of organic complexants are documented in *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements* (Schreiber 1997). Although the organic complexants memorandum of understanding was not in effect until after sampling and analysis were completed, the results can be assessed against these requirements. Energetics by DSC and sample moisture analyses were conducted to address the organic complexants issue.

The DSC dry weight exceeded 480 J/g in six of the samples. As a result, TOC analyses were run. Total organic carbon results were well below 3.0 percent dry weight in all samples. Total organic carbon furnace oxidation was run on drainable liquid samples where exotherms were observed. The maximum TOC for solids was 0.655 percent dry weight and 0.533 percent dry weight for drainable liquids. The minimum percent water content in the solids was 24.1 percent. An analysis of variance (ANOVA) conducted in accordance with Schreiber (1997) showed that this tank should be classified "safe" for the organic complexant issue. Analysis of variance results for this tank and an updated safety classification will be included in a revision to the organic complexants topical report (Meacham et al. 1997b). The organic complexants issue is expected to be closed out for all tanks in fiscal year 1998.

2.4 HAZARDOUS VAPOR SAFETY SCREENING

The data required to support vapor screening are documented in *Data Quality Objectives for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995). The vapor screening DQO addresses two issues: 1) does the vapor in the tank headspace exceed 25 percent of the LFL, and if so, what are the principal fuel components; and 2) does the potential exist for worker hazards associated with the toxicity of constituents in any fugitive vapor emissions from these tanks?

2.4.1 Flammable Gas

This is the same requirement as the safety screening flammability requirement. As noted previously, the maximum flammable gas level detected in the tank headspace was one percent of the LFL. This is well below the safety screening limit of 25 percent.

2.4.2 Toxicity

The vapor screening DQO requires the analysis of ammonia (NH_3), carbon dioxide (CO_2), carbon monoxide (CO), nitric oxide (NO), nitrous oxide (N_2O), and nitrogen dioxide (NO_2) from a sample. The vapor screening DQO specifies a threshold limit for each of these compounds. Data from the June 13, 1996, vapor sampling event (Evans et al. 1997) were used to address the issue of toxicity (see Appendix B). All of the analytes were within the threshold limits. Ammonia was the only vapor constituent of concern and was measured at 37 ppmv, below the 150 ppmv limit. The toxicity issue has been closed for all tanks (Hewitt 1996).

2.5 ORGANIC SOLVENTS SAFETY SCREENING

The data required to support the organic solvent screening issue are documented in the *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997a). The DQO requires tank headspace samples be analyzed for total nonmethane organic compounds to determine whether any significant organic extractant pool exists in the tank. The purpose of this assessment is to ensure that an organic solvent pool fire or ignition of organic solvents cannot occur. The organic solvents issue is expected to be closed in fiscal year 1998.

Analytical results showed that the concentration of total nonmethane organic compounds (semivolatile species) in tank headspace vapors was 2.0 mg/m^3. The size of the vapor pool was estimated to be 0.13 m^2 (1.4 ft^2), below the 1 m^2 (10.8 ft^2) limit (Huckaby et al. 1997).

2.6 HISTORICAL EVALUATION

The purpose of the historical evaluation is to determine whether the model inventories based on process knowledge and historical information (Agnew et al. 1997) agree with current tank inventories. If the historical model accurately predicts the waste characteristics, as observed through sample characterization, the possibility exists to reduce the amount of total sampling and analysis needed. Data requirements for this evaluation are documented in *Historical Model Evaluation Data Requirements* (Simpson and McCain 1997).

A "gateway" analysis is a quick check to ensure that the data obtained from sampling support the remainder of the historical evaluation analysis. Failure of the gateway analysis indicates the model waste composition estimate is not comparable to the sample data and the tank is not a good tank on which to perform the historical model evaluation. If the gateway analysis fails, the remainder of the sampling and analysis for the historical DQO will not be applied to the tank. If the gateway analysis passes, then further analyses will be performed on the waste samples as specified in the historical model evaluation DQO. Results of the historical model evaluation DQO will be used to quantify the errors associated with the historical tank content estimates (Simpson and McCain 1997).

The gateway analysis was applied to each core sample taken from tank 241-S-106 in February/March 1997. The fingerprint analytes for tank 241-S-106 are chromium, sodium, aluminum, water, nitrate, carbonate, and sulfate. These analytes were chosen because Agnew et al. (1997) predicts that the tank waste is composed primarily of saltcake waste generated from the 242-S Evaporator from 1973 through 1976 (SMMS1). The gateway analysis required two tests be performed for each sample. The first test was to determine if the concentration of each of the gateway analytes was greater than 10 percent of the predicted concentration (as specified in the DQO). The second test was to determine whether the gateway analytes contributed to more than 85 percent (by mass) of the total waste. The gateway analysis for tank 241-S-106 is shown in Appendix C.

All fingerprint analytical values were greater than 10 percent of the predicted values for SMMS1 saltcake. The fingerprint analytes also accounted for greater than 85 percent of the waste mass in all segments except 183:5 lower half and 184:9 lower half. The fingerprint analytes accounted for 72.7 and 73.9 percent, respectively, for these two segments.

Segment 9, lower half, was predicted to contain CWR1 based on process history. This could explain why segment 9, lower half, did not pass the gateway analysis. However, the waste in segment 9, lower half, did not exhibit the characteristics of a CWR1 sludge as expected. Segment 5 should be SMMS1 waste. Although core 183, segment 5, failed the gateway analysis, it was selected for further comparison with the Hanford defined waste (HDW) estimate for this tank because it is expected to be saltcake waste. Segment 184:6, upper half, was also selected for this analysis. Core composites were not prepared because the top four segments of the tank were mostly drainable liquid, and because core 184 was incomplete.

All analytes measured were greater than 10 percent of the HDW tank waste estimates. Many HDW predictions were within 20 percent of the analytical results.

2.7 OTHER TECHNICAL ISSUES

A factor in assessing tank safety is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. The tank heat load estimate based on the 1997 sample event was 1,762 W (65.9 Btu/hr) (see Table 2-2). This estimate compares with a heat load estimate based on tank temperature of 3,875 Btu/hr (Kummerer 1995) and a heat load based on the tank process history of 3,660 W (12,500 Btu/hr) (Agnew et al. 1997). Both these estimates are below the limit of 11,700 W (400,000 Btu/hr) that separates high- and low-heat-load tanks (Smith 1986).

Table 2-2. Heat Load Estimate for Tank 241-S-106 Based on Radionuclide Inventory.

Radionuclide	Inventory[1] (Ci)	Decay Heat Rate (W/Ci)	Heat Load (W)
^{137}Cs	313,000	0.00472	1,477
^{90}Sr	42,500	0.00670	285
Total			**1,762**

Note:

[1]See Appendix D.

2.8 SUMMARY

The results of all analyses performed to address potential safety issues showed that only exothermic activity exceeded safety decision threshold limits. As discussed previously, the high exotherms were not consistent with TOC energy equivalent calculations. Total organic carbon results and high moisture content indicate that a propogating reaction is unlikely. All requirements for the safety screening and organic complexant issues were met, except only one complete push core sample could be obtained.

Retained gas sampler measurements showed a high volume of retained gases in the samples analyzed. The gas consists of 63 percent hydrogen and 24 percent nitrogen, with an estimated volume of 410 $\pm$130 m^2.

Historical DQO requirements were met, except that core composite samples were not analyzed because of the small amount of solids recovered in the upper half portion of the tank waste. In general, segment sample results were consistent with the S1 saltcake waste type.

Vapor samples were taken to meet the organic solvents and hazardous vapor safety screening DQO requirements.

Sample results are summarized in Table 2-3.

Table 2-3. Summary of Technical Issues.

Issue	Sub-issue	Result
Safety screening	Energetics	Six exotherms exceeded 480 J/g but had low TOC and high moisture. A propogating reaction is unlikely.
	Flammable gas	Vapor measurement reported <1 percent of the LFL .
	Criticality	All analyses were well below 46.6 μCi/g total alpha (within 95 percent confidence limit on each sample).
Flammable gas	Mechanisms for generation, retention and release Waste models	Ten% of the waste volume consisted of retained gases (410 $\pm$ 130 m^3) with 63% hydrogen content. Preliminary assessments of flammable gas generation, retention, and release mechanisms, and waste behavior modeling results are reported in Mahoney et al. (1997). Additional evaluations to assess potential impacts and waste behavior in tank 241-S-106 are in progress.
Organic complexants[1]	Safety categorization	Safe, low TOC, no visible layers
Hazardous vapor	Flammability	See safety screening - flammable gas
	Toxicity	All analytes were within the toxicity threshold limits except ammonia.
Organic solvents[1]	Solvent pool size	Total nonmethane organic compounds were 2.0 mg/m^3. The estimated organic solvent pool size was 0.13 m^2, below the 1 m^2 limit.
Historical (gateway analysis)	Total mass of gateway analytes	Greater than 85% by weight of the waste, except core 183, segments 5L and 9L.
	Selected segment comparison with $\geq$10% of DQO values	All segments and analytes passed.
	Core composite comparison with HDW	All segments and analytes $\geq$10% of HDW model estimates. Most values within 20% of HDW model estimates.

Note:

[1]The organic solvents and organic complexants safety issues are expected to be closed in fiscal year 1998.

3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-S-106 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task. The following information was used in the evaluation:

- Analytical results for two, 1997 push-mode core samples
- Tank waste photographs
- The inventory estimate generated by the HDW model (Agnew et al.1997)
- An engineering evaluation that estimated average SMMS1 concentrations based on available sample results for S and U farm tanks containing SMMS1 waste.

Based on this evaluation, a best-basis inventory was developed for tank 241-S-106. The sampling/engineering-based inventory was chosen as the best basis for those analytes for which analytical values were available. The engineering inventory was calculated assuming a supernatant pool size of 201 kL (53 kgal). The remainder of the waste 1,612 kL (426 kgal) is SMMS1 saltcake. Although a bottom sludge layer of R/CWR waste was predicted by Agnew et al. (1997b) and Hanlon (1998), no R/CWR waste was observed in 1997 core samples. Results from similar S and U Farm tanks were used to estimate analyte inventories where sample data was not available for tank 241-S-106. HDW model results were used if no sample based information was available.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, and so forth, have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al.[1997], Section 6.1 and in Watrous and Wootan [1997]). Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997b). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result, if available.

The best-basis inventory estimate for tank 241-S-106 is presented in Tables 3-1 and 3-2. Because there was no analysis for mercury, the HDW model value was used.

The inventory values reported in Tables 3-1 and 3-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-106 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	54,000	S	
Bi	334	S	
Ca	339	S/E	Based on average SMMS1 values.
Cl	9,610	S	
TIC as CO_3	95,600	S	
Cr	16,800	S	
F	6,450	S	
Fe	4,630	S	
Hg	23.3	E	
K	2,210	S	
La	0	E	No La expected in evaporator supernatants
Mn	173	S	
Na	6.24E+05	S	
Ni	81.3	S	
NO_2	88,100	S	
NO_3	1.05E+06	S	
OH_{TOTAL}	1.55E+05	C	
Pb	194	S	Upper-bound sample result "less than detect"
PO_4	63,300	S	Based on IC analysis
Si	1,330	S	
SO_4	23,000	S	Based on IC analysis

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-106 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Sr	17.1	S	Upper-bound sample result "less than detect"
TOC	6,110	S	
U_{TOTAL}	961	S	Upper-bound sample result "less than detect"
Zr	19.9	S	Upper-bound sample result "less than detect"

[1]S = Sample-based (See Appendix B)
M = Hanford defined waste model-based, Agnew et al. (1997b)
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	478	M	
^{14}C	58.4	M	
^{59}Ni	3.82	M	
^{60}Co	60.3	S	Upper bound sample result "less than detect", solids only.
^{63}Ni	372	M	
^{79}Se	6.05	M	
^{90}Sr	41,800	S	Solids only
^{90}Y	41,800	S	Based on ^{90}Sr activity
^{93}Zr	29.6	M	
^{93m}Nb	21.8	M	
^{99}Tc	418	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{106}Ru	0.00981	M	
^{113m}Cd	149	M	
^{125}Sb	246	M	
^{126}Sn	9.15	M	
^{129}I	0.805	M	
^{134}Cs	2.92	M	
^{137}Cs	2.81E+05	S	Solids only
^{137m}Ba	2.66E+05	S	Based on 0.946 of ^{137}Cs activity
^{151}Sm	21,300	M	
^{152}Eu	5.34	M	
^{154}Eu	203	S	Upper-bound sample result "less than detect", solids only.
^{155}Eu	752	S	Upper-bound sample result "less than detect", solids only.
^{226}Ra	2.67 E-04	M	
^{227}Ac	0.00161	M	
^{228}Ra	0.0874	M	
^{229}Th	2.09E-03	M	
^{231}Pa	7.24E-03	M	
^{232}Th	6.03E-03	M	
^{232}U	0.0582	S/M	Based on ICP U sample result ratioed to HDW estimates for U isotopes.
^{233}U	0.223	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{234}U	0.336	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{235}U	0.0140	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{236}U	0.00849	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{237}Np	1.64	M	
^{238}Pu	0.996	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{238}U	0.321	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{239}Pu	52.8	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{240}Pu	7.80	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{241}Am	19.4	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{241}Pu	59.3	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{242}Cm	0.0365	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{242}Pu	2.83E-04	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{243}Am	5.86E-04	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{243}Cm	0.00329	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{244}Cm	0.0368	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.

Notes:

ICP = inductively coupled plasma spectroscopy

[1]S = Sample-based (See Appendix B)
M = Hanford defined waste model-based, Agnew et al. (1997b)
E = Engineering assessment-based.

4.0 RECOMMENDATIONS

Push-mode core samples and vapor samples were taken to satisfy applicable issues for tank 241-S-106. Only one complete core (core 183, riser 8) was obtained because core 184, riser 7, and core 187, riser 14, were too hard to push. Nevertheless, analytical results for the samples obtained showed that there are no safety screening issues or organic complexant issues of concern. Although exotherms exceeding 480 J/g were observed, the tank is classified as safe for the organic complexant issue because low levels of TOC were found by both the persulfate and furnace oxidation methods.

Retained gas samples were taken to evaluate flammable gas issues. Results of these tests are presented in Appendix B. The RGS results and gas bubble retention test results (not available at the time this TCR was written) are being evaluated to further address the flammable gas DQO.

Vapor samples showed that ammonia is the only toxic vapor that exceeds limits, and the LFL in the tank headspace is <1 percent. The organic solvent pool size was estimated to be well below 1 m^2.

The tank waste samples passed the historical evaluation for most segments. However, composite samples were not obtained because the top four segments of the tank were drainable liquid, and core 184 was not a full core.

Table 4-1 summarizes the Project Hanford Management Contractor (PHMC) TWRS Program review status and acceptance of the sampling and analysis results reported in this TCR. All issues required to be addressed by sampling and analysis are listed in column 1 of Table 4-1. Column 2 indicates by "yes" or "no" whether the requirements were met by the sampling and analysis activities performed. Column 3 indicates concurrence and acceptance by the program in PHMC/TWRS that is responsible for the issue that the sampling and analysis activities performed adequately. A "yes" or "no" in column 3 indicates acceptance or disapproval of the sampling and analysis information in the TCR.

Table 4-1. Acceptance of Tank 241-S-106 Sampling and Analysis.

Issue	Sampling and Analysis Performed	Program[1] Acceptance
Safety screening DQO	Yes	Yes
Flammable gas DQO	Yes	Yes
Organic complexant memorandum of understanding	Yes	Yes
Hazardous vapor screening DQO	Yes	Yes
Organic solvents DQO	Yes	Yes
Historical evaluation DQO	Yes	Yes

Note:

[1]PHMC TWRS Program Office

Table 4-2 summarizes the status of PHMC TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. Column 1 lists the different evaluations performed in this report. Columns 2 and 3 are in the same format as Table 4-1. The manner in which concurrence and acceptance are summarized is also the same as that in Table 4-1. The safety screening categorization of the tank is listed as "partial" in Table 4-2 because two full-depth cores were not obtained. However, the safety program has determined that the samples obtained were representative of tank contents and no additional sampling is required to resolve this issue. The flammable gas issue for this tank will be resolved concurrently with all other tanks in fiscal year 2001.

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-S-106.

Issue	Evaluation Performed	TWRS[1] Program Acceptance
Safety screening DQO	Partial	Yes
Flammable gas DQO	(in progress)	NA
Organic complexant memorandum of understanding (Safe)	Yes	Yes
Organic solvents DQO	Yes	Yes
Historical evaluation DQO	Yes	Yes

Notes:

N/D = not decided

[1]PHMC TWRS Program Office

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5.0 REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Bauer, R. E. and L. P. Jackson, 1997, *Data Quality Objective to Support Resolution of the Flammable Gas Safety Issue*, HNF-SD-WM-DQO-004, Rev. 3, Duke Engineering and Services Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Brown, T. M., J. W. Hunt, and L. J. Fergestrom, 1997, *Tank Characterization Technical Sampling Basis*, HNF-SD-WM-TA-164, Rev. 3, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Buckley, L. L., 1997, *Push-Mode Core Sampling and Analysis Plan for Tank 241-S-106*, HNF-SD-WM-TSAP-124, Rev. 0C, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Ecology, EPA, and DOE, 1997, *Hanford Federal Facility Agreement and Consent Order,* as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Esch, R. A., 1997, *Tank 241-S-106, Cores 183, 184 and 187 Analytical Results for the Final Report*, HNF-SD-WM-DP-242, Rev. 0, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Evans, J. C., K. H. Pool, B. L. Thomas, K. B. Olson, J. S. Fruchter, and K. L. Silvers, 1997, *Headspace Vapor Characterization of Hanford Tank 241-S-106: Results from Samples Collected on 06/13/96*, PNNL-11260, Pacific Northwest National Laboratory, Richland, Washington.

Hanlon, B. M., 1998, *Waste Tank Summary Report for Month Ending November 30, 1997*, HNF-EP-0182-116, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Hewitt, E. R., 1996, *Tank Waste Remediation System Resolution of Potentially Hazardous Vapor Issues*, WHC-SD-TWR-RPT-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hodgson, K. M., and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks,* WHC-SD-WM-WP-311, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., J. A. Glissmeyer, and D. S. Sklarew, 1997, *Screening for Organic Solvents in Hanford Waste Tanks Using Total Non-Methane Organic Compound Vapor Concentrations*, PNNL-11490, Pacific Northwest National Laboratory, Richland, Washington.

Johnson, G. D., 1997, *Strategy for Resolution of the Flammable Gas Safety Issue*, HNF-SD-WM-ER-680, Rev. 0, DE&S Hanford Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Kummerer, 1995, *Heat Removal Characteristics of Waste Storage Tanks*, WHC-SD-WM-SARR-010, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, R. A. Watrous , S. L. Lambert, D. E. Place, R. M. Orme, G. L. Borsheim, N. G. Colton, M. D. LeClair, R. T. Winward, and W. W. Schulz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD- WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Mahoney, L. A., Z. I. Antoniak, and J. M. Bates, 1997, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-U-103, S-106, BY-101, and BY-109*, PNNL-11777, Pacific Northwest National Laboratory, Richland, Washington.

Meacham, J. E., D. L. Banning, M. R. Allen, and L. D. Muhlestein, 1997a, *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue*, HNF-SD-WM-DQO-026, Rev. 0, Duke Engineering & Services, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Meacham, J. E., A. B. Webb, N. W. Kirch, J. A. Lechelt, D. A. Reynolds, G. S. Barney, D. M. Camaioni, F. Gao, R. T. Hallen, and P. G. Heasler, 1997b, *Organic Complexant Topical Report*, HNF-SD-WM-CN-058, Rev. 1, Duke Engineering & Services, Inc., for Fluor Daniel Hanford, Inc., Richland, Washington.

Osborne, J. W., and L. L. Buckley, 1995, *Data Quality Objectives for Tank Hazardous Vapor Safety Screening*, WHC-SD-WM-DQO-002, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Public Law 101-510, 1990, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," Section 3137 of *National Defense Authorization Act for Fiscal Year 1991*.

Schreiber, R. D., 1997, *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements*, HNF-SD-WM-RD-060, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Simpson, B. C., and D. J. McCain, 1997, *Historical Model Evaluation Data Requirements*, HNF-SD-WM-DQO-018, Rev. 2, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Smith, D. A., 1986, *Single-Shell Tank Isolation Safety Analysis Report*, WHC-SD-WM-SAR-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989,* HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-S-106 based on historical information. For this report, historical information includes any information about the fill history, waste types, surveillance, or modeling data about the tank. This information is necessary for providing a balanced assessment of the sampling and analytical results.

This appendix contains the following information.

- **Section A1.0:** The tank's current status, including the current waste levels as well as the stabilization and isolation status of the tank
- **Section A2.0:** Information about the tank design
- **Section A3.0:** Process knowledge of the tank, that is, the waste transfer history and the estimated contents of the tank based on modeling data
- **Section A4.0:** Surveillance data for the tank , including surface-level readings, temperatures, and a description of the waste surface based on photographs
- **Section A5.0:** Appendix A References.

Historical sampling results (results from samples obtained before 1989) are included in Appendix B.

A1.0 CURRENT TANK STATUS

As of November 30, 1997, tank 241-S-106 contained an estimated 1,813 kL (479 kgal) of waste classified as noncomplexed (Hanlon 1998). A supernatant volume of 201 kL (53 kgal) was estimated based on sample results and a photographic evaluation. This differs from the Hanlon value of 15 kL (4 kgal). Rationale and calculations for the new supernatant inventory are presented in Appendix D. A solid waste volume of 1,612 kL (426 kgal) was determined by subtracting the supernatant volumes from the total volume of the tank. It was estimated using a combination of a photographic evaluation and a surface-level gauge. The solid waste volume was last updated on December 31, 1993. The amounts of various waste phases in the tank are presented in Table A1-1.

Tank 241-S-106 is out of service, as are all single-shell tanks, and is categorized as sound. The tank is not on any Watch Lists. The tank is passively ventilated and partially interim isolated. All monitoring systems were in compliance with documented standards as of November 30, 1997 (Hanlon 1998).

Table A1-1. Tank Contents Status Summary.

Waste type	kL (kgal)
Total waste[1]	1,813 (479)
Supernatant liquid[2]	201 (53)
Sludge[2]	0 (0)
Saltcake[2]	1,612 (426)
Drainable interstitial liquid[2]	0 (0)
Drainable liquid remaining	201 (53)
Pumpable liquid remaining	201 (53)

Note:

[1]Hanlon (1998)
[2]See Appendix D

A2.0 TANK DESIGN AND BACKGROUND

The 241-S Tank Farm was constructed during 1950 and 1951 in the 200 West Area. The farm contains twelve 100 series tanks. Each tank has a capacity of 2,869 kL (758 kgal), a diameter of 23 m (75 ft), and an operating depth of 7 m (23 ft) (Leach and Stahl 1993). Built according to the second generation design, the 241-S Tank Farm was designed for waste with a maximum fluid temperature of 104 °C (220 °F) (Ewer et al. 1997). A cascade line 76 mm (3 in.) in diameter connects tank 241-S-106 as third in a cascade series of three tanks beginning with tanks 241-S-104 and 241-S-105. Each tank in the cascade series is set one foot lower in elevation from the preceding tank.

Tank has a dished bottom with a 1.2-m (4-ft) radius knuckle. The tank was designed with a primary mild steel liner (ASTM A283 Grade B) and a concrete dome with various risers. The tank is set on a reinforced concrete foundation. The tank and foundation were waterproofed by a coating of tar covered by a three-ply, asphalt-impregnated, waterproofing fabric. The waterproofing was protected by welded-wire-reinforced gunite. One coat of primer was sprayed on all exposed interior tank surfaces. The ceiling of the tank dome was covered with six applications of a vinyl resin coating (Rutherford 1949). Lead flashing was used to protect the joint where the steel liner meets the concrete dome. Asbestos gaskets were used to seal the risers in the tank dome.

Tank 241-S-106 has 12 risers according to the drawings and engineering change notices. The risers range in diameter from 102 mm (4 in.) to 1.07 m (42 in.). Table A2-1 shows numbers, diameters, and descriptions of the risers and the nozzles. A plan view that depicts the riser and nozzle configuration is shown in Figure A2-1. Risers 11, 14, and 16 (102 mm [4 in.] in diameter) and risers 6 and 8 (305 mm [12 in.] in diameter) are available for sampling (Lipnicki 1997). A tank cross-section showing the approximate waste level along with a schematic of the tank equipment is in Figure A2-2.

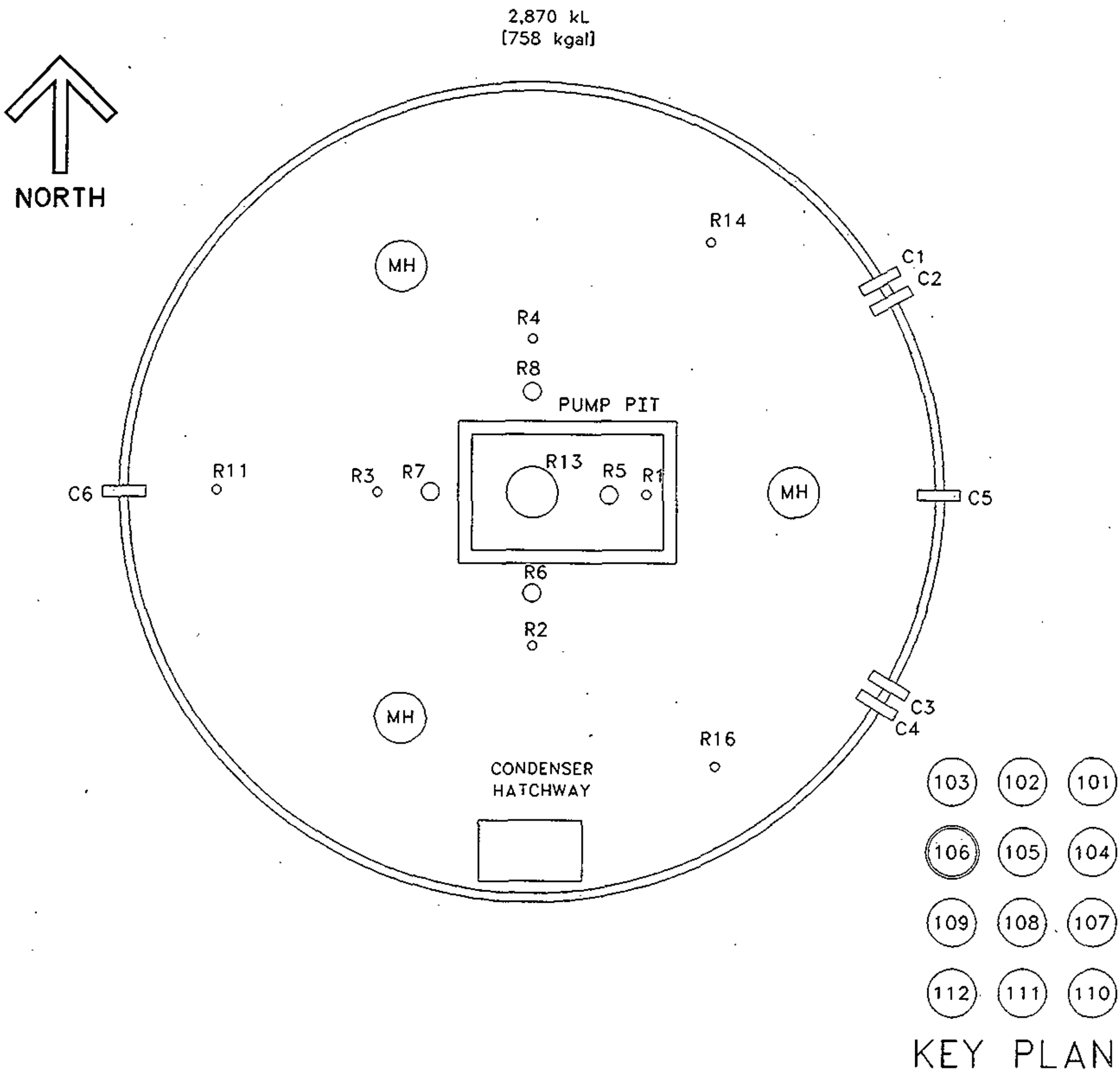


Figure A2-1. Riser Configuration for Tank 241-S-106.

Table A2-1. Tank 241-S-106 Risers.[1]

Number	Diameter (in.)	Description and Comments
R1	4	Pit drain/connector nozzle
R2	4	Thermocouple tree (Benchmark CEO-36907 12/11/86)[2]
R3	4	ENRAF[3] (ECN-608115 5/12/94)
R4	4	B-436 liquid observation well
R5	12	Saltwell screen and pump
R6[B4]	12	Spare (Unusable CE0-41062 3/17/87)
R7	12	Ventilation Duct (Blank CE0-41062 3/17/87) (Duct removed & riser capped ECN-706501 8/29/95)
R8[B4]	12	B-222 observation port
R11[B4]	4	Sludge measurement port
R13	42	Slurry distributor
R14[B4]	4	Sludge measurement port
R16[B4]	4	Sludge measurement port (Benchmark CEO-36907 12/11/86) (Breather Filter CE0-41062 3/17/87)
C1	3	Spare nozzle, capped
C2	3	Spare nozzle, capped
C3	3	Spare nozzle, capped
C4	3	Spare nozzle, capped
C5	3	Inlet
C6	3	Outlet, capped

Notes:

CEO = change engineering order
ECN = engineering change notice

[1]Alstad (1993), Tran (1993), and Vitro (1988)
[2]Dates are in the mm/dd/yy format
[3]ENRAF is a trademark of ENRAF Corporation, Houston, Texas

[B4]Denotes risers tentatively available for sampling (Lipnicki 1997).

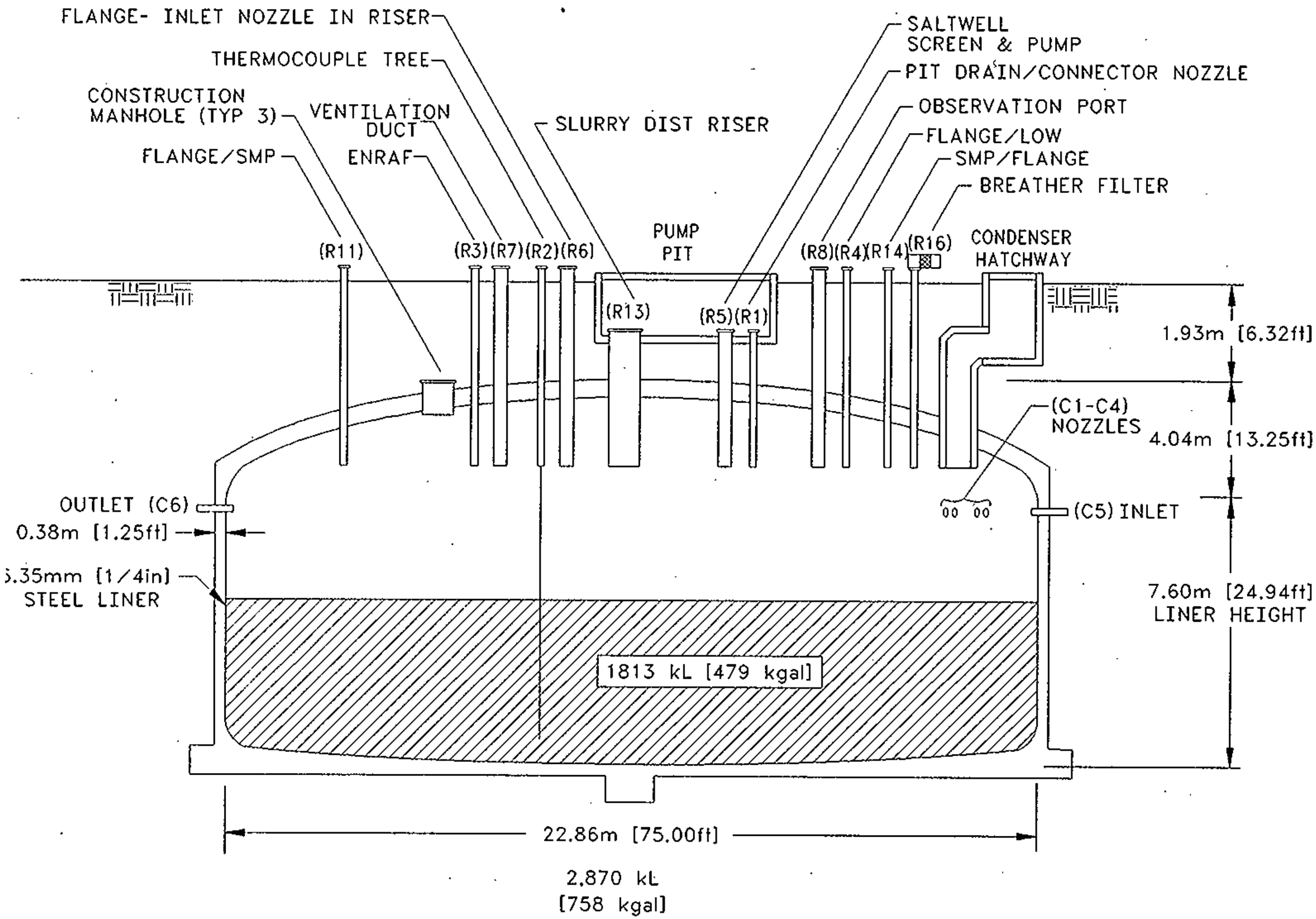


Figure A2-2. Tank 241-S-106 Cross Section and Schematic.

A3.0 PROCESS KNOWLEDGE

The following sections: 1) provide information about the waste transfer history of tank 241-S-106, 2) describe the process wastes that were transferred, and 3) give an estimate of the current tank contents based on waste transfer history.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-S-106 (Agnew et al. 1997b). Tank 241-S-106 first began receiving waste in the form of CWR1 via the cascade from tank 241-S-105 in the second quarter of 1953. The addition of waste through this cascade ended in the third quarter of 1953. Tank 241-S-106 received flush waste in the third quarter of 1955. Waste was sent to tank 241-S-103 from tank 241-S-106 in the second quarter of 1955. An addition of supernatant waste from tank 241-S-107 into tank 241-S-106 was made during the fourth quarter of 1955.

No waste transfers involving tank 241-S-106 occurred until the fourth quarter of 1973 when supernatant evaporator bottoms waste was sent to tanks 241-S-110 and 241-U-107. Tank 241-S-106 began exchanging evaporator bottoms waste with tank 241-S-102 from the fourth quarter of 1973 through the first quarter of 1975. The waste exchange supported the operation of the 242-S Evaporator. (Tank 241-S-102 was the feed tank.) Tank 241-S-106 sent waste to tank 241-SY-102 in the second quarter of 1979. Tank 241-S-106 was then saltwell pumped twice: in the fourth quarter of 1983 when pumped liquids were sent to tank 241-AY-102, and during the first quarter of 1984 when the pumped liquid waste directed to tank 241-AN-103.

Table A3-1. Tank 241-S-106 Major Waste Transfers.[1,2]

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
241-S-105		CWR1	1953	2,740	724
	271-S-103	SU	1955	-651	-172
241-S-107		SU	1955	689	182
Miscellaneous sources		Flush waste	1955	121	32
	241-S-110, 241-U-107	SU	1973	-129	-34
241-S-102		EB	1973 - 1975	10,871	2,872
	241-S-102	SU	1973 - 1975	-11,052	-2,920
	241-SY-102	SU	1979	-344	-91
	241-AY-102	SWLIQ	1983	-254	-67
	241-AN-103	SWLIQ	1984	-238	-63

Notes:

Waste volumes and types are best estimates based on historical data.
CWR1 = REDOX cladding waste (1952 to 1960)
EB = Evaporator bottoms and recycle waste from 242-S Evaporator
SU = supernatant
SWLIQ = Dilute, noncomplexed waste from single-shell tanks

[1]Agnew et al. (1997b)

[2]Because only major transfers are listed, the sum of these transfers will not equal the current tank waste volume.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

The historical transfer data used for this estimate are from the following sources:

- The *Waste Status and Transaction Record Summary: WSTRS, Rev. 0,* (Agnew et al. 1997b) is a tank-by-tank quarterly summary spreadsheet of waste transactions.

- The *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4* (Agnew et al. 1997a) contains the HDW list, the supernatant mixing model (SMM), the tank layer model (TLM), and the historical tank content estimate (HTCE).

- The HDW list is comprised of approximately 50 waste types defined by concentration for major analytes/compounds for sludge and supernatant layers.

- The TLM defines the sludge and saltcake layers in each tank using waste composition and waste transfer information.

- The SMM is a subroutine within the HDW model that calculates the volume and composition of certain supernatant blends and concentrates.

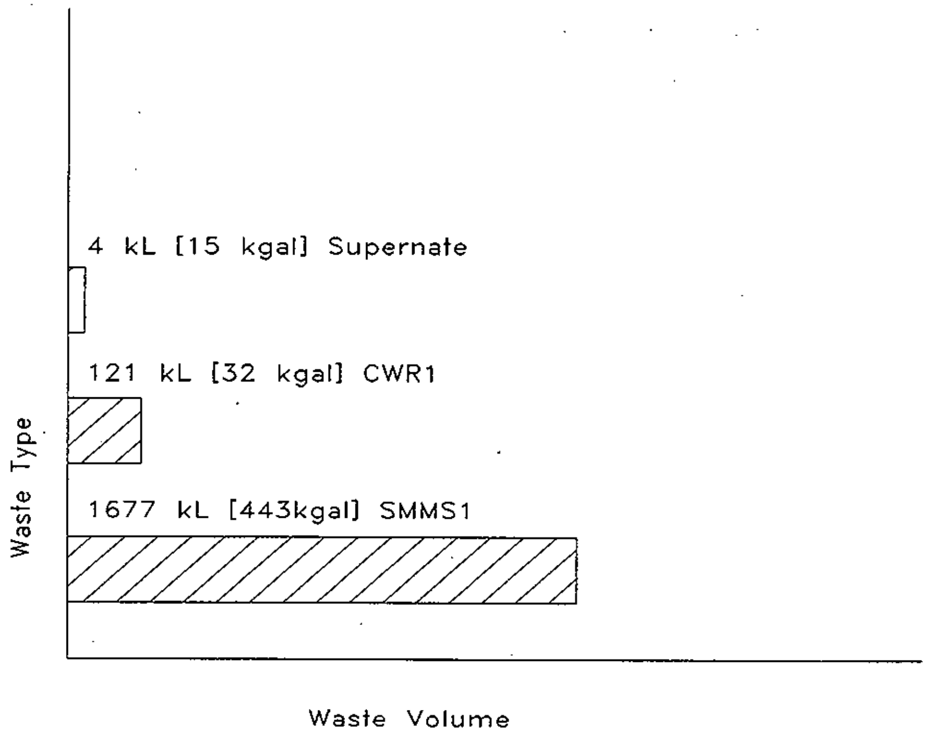
Using these records, the TLM defines the sludge and saltcake layers in each tank. The SMM uses information from the waste status and transaction record summary (WSTRS), the TLM, and the HDW list to describe the supernatants and concentrates in each tank. Together, the WSTRS, TLM, SMM, and HDW list determine the inventory estimate for each tank. These model predictions are considered estimates that require further evaluation using analytical data.

Based on the TLM and the SMM, tank 241-S-106 contains a bottom solids layer of 121 kL (32 kgal) of CWR1 and a top layer of 1,677 kL (443 kgal) of concentrated supernatant solids from 242-S saltcake waste (SMMS1). A top layer of 15 kL (4 kgal) of supernatant is above the solid waste surface. Figure A3-1 shows the TLM estimated waste types and volumes for each tank layer.

The CWR1 layer should contain, from highest concentration above one weight percent, the following constituents: hydroxide, aluminum, sodium, nitrite, uranium, nitrate, and lead. Constituents contained in this layer above a tenth of a weight percent are: iron, carbonate, and calcium. Tables A3-2 and A3-3 show the HDW estimates for the expected analyte and radionuclide waste constituents and concentrations.

As shown in Appendix D, the CWR1 layer was not observed in tank samples, the supernatant layer was larger, and the solids layer smaller than predicted by Agnew (1997a) and Hanlon (1998).

Figure A3-1. Tank Layer Model Volume Estimates.



Note: TLM volume estimates are different from current tank volumes.

Table A3-2. Historical Tank Inventory Estimate Analytes.[1,2] (2 sheets)

Total Inventory Estimate					
Physical Properties				**-95 CI**	**+95 CI**
Total waste	3.02E+06 (kg) (479 kgal)				
Heat load	3.66 (kW) (1.25E+04 Btu/hr)			3.47	3.85
Bulk density	1.66 (g/cc)			1.61	1.70
Water wt%	30.6			28.5	33.6
TOC wt% C (wet)	0.317			0.284	0.350
Chemical Constituents	***M***	**ppm**	**kg**	**-95 CI (*M*)**	**+95 CI (*M*)**
Na^+	14.7	2.03E+05	6.12E+05	13.5	15.5
Al^{3+}	2.69	4.36E+04	1.31E+05	2.31	2.99
Fe^{3+} (total Fe)	1.96E-02	659	1.99E+03	1.80E-02	2.13E-02
Cr^{3+}	0.193	6.04E+03	1.82E+04	0.150	0.208
Bi^{3+}	6.11E-04	76.8	232	5.52E-04	6.70E-04
La^{3+}	3.05E-08	2.55E-03	7.69E-03	2.24E-08	3.87E-08
Hg^{2+}	2.78E-04	33.5	101	2.74E-04	2.80E-04
Zr (as $ZrO(OH)_2$)	1.24E-04	6.78	20.4	1.13E-04	1.34E-04
Pb^{2+}	8.52E-03	1.06E+03	3.20E+03	7.88E-03	8.98E-03
Ni^{2+}	5.57E-03	197	593	5.40E-03	5.78E-03
Sr^{2+}	0	0	0	0	0
Mn^{4+}	2.84E-03	93.8	283	2.05E-03	3.63E-03
Ca^{2+}	3.61E-02	869	2.62E+03	3.25E-02	3.93E-02
K^+	5.95E-02	1.40E+03	4.22E+03	5.42E-02	6.46E-02
OH^-	14.7	1.50E+05	4.52E+05	13.2	15.9
NO_3^-	4.64	1.73E+05	5.22E+05	4.30	4.80
NO_2^-	2.77	7.67E+04	2.31E+05	2.43	3.11
CO_3^{2-}	0.279	1.01E+04	3.04E+04	0.252	0.301
PO_4^{3-}	5.32E-02	3.04E+03	9.15E+03	4.81E-02	5.56E-02
SO_4^{2-}	0.173	9.98E+03	3.01E+04	0.129	0.217
Si (as SiO_3^{2-})	6.81E-02	1.15E+03	3.47E+03	5.68E-02	7.94E-02
F^-	2.92E-02	333	1.00E+03	2.40E-02	3.37E-02
Cl^-	0.240	5.11E+03	1.54E+04	0.216	0.256
$C_6H_5O_7^{3-}$	2.18E-02	2.48E+03	7.48E+03	2.02E-02	2.34E-02

Table A3-2. Historical Tank Inventory Estimate Analytes.[1,2] (2 sheets)

Total Inventory Estimate					
$EDTA^{4-}$	1.96E-03	340	1.02E+03	9.93E-04	2.95E-03
$HEDTA^{3-}$	3.22E-03	531	1.60E+03	1.28E-03	5.19E-03
$Glycolate^{-}$	4.18E-02	1.89E+03	5.69E+03	2.28E-02	6.09E-02
$Acetate^{-}$	2.27E-03	80.5	243	1.84E-03	2.70E-03
Chemical Constituents	***M***	**ppm**	**kg**	**-95 CI (*M*)**	**+95 CI (*M*)**
$Oxalate^{2-}$	4.00E-08	2.12E-03	6.38E-03	3.56E-08	4.44E-08
DBP	1.41E-02	1.78E+03	5.37E+03	1.13E-02	1.68E-02
Butanol	1.41E-02	628	1.89E+03	1.13E-02	1.68E-02
NH_3	6.94E-02	710	2.14E+03	5.67E-02	9.07E-02
$Fe(CN)_6^{4-}$	0	0	0	0	0

Notes:

CI = confidence interval
M = moles per liter
ppm = parts per million

[1]Agnew et al. (1997a)
[2]The HTCE predictions have not been validated and should be used with caution.

Table A3-3. Historical Tank Inventory Estimate Radionuclides.[1,2] (3 sheets)

Total Inventory Estimate					
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	2.63E-04	0.158	478	1.63E-04	2.71E-04
C-14	3.22E-05	1.94E-02	58.	1.11E-05	3.27E-05
Ni-59	2.11E-06	1.27E-03	3.82	1.12E-06	2.21E-06
Ni-63	2.05E-04	0.123	372	1.07E-04	2.15E-04
Co-60	3.30E-05	1.99E-02	59.9	8.89E-06	3.37E-05
Se-79	3.34E-06	2.01E-03	6.05	1.99E-06	4.29E-06
Sr-90	0.105	62.9	1.90E+05	9.80E-02	0.111
Y-90	0.105	62.9	1.90E+05	5.81E-02	0.111
Zr-93	1.63E-05	9.82E-03	29.6	9.60E-06	2.11E-05
Nb-93m	1.20E-05	7.22E-03	21.8	7.30E-06	1.53E-05
Tc-99	2.31E-04	0.139	418	1.52E-04	3.10E-04

Table A3-3. Historical Tank Inventory Estimate Radionuclides.[1, 2] (3 sheets)

Total Inventory Estimate					
Radiological Constituents	Ci/L	μCi/g	Ci	-95 CI (Ci/L)	+95 CI (Ci/L)
Ru-106	5.41E-09	3.25E-06	9.81E-03	2.29E-09	6.74E-09
Cd-113m	8.23E-05	4.95E-02	149	4.19E-05	1.11E-04
Sb-125	1.36E-04	8.17E-02	246	3.14E-05	1.39E-04
Sn-126	5.05E-06	3.04E-03	9.15	3.03E-06	6.48E-06
I-129	4.44E-07	2.67E-04	0.805	2.92E-07	5.98E-07
Cs-134	1.61E-06	9.67E-04	2.92	8.49E-07	1.78E-06
Cs-137	0.280	168	5.08E+05	0.258	0.303
Ba-137m	0.265	159	4.80E+05	0.164	0.278
Sm-151	1.18E-02	7.07	2.13E+04	7.05E-03	1.51E-02
Eu-152	2.95E-06	1.77E-03	5.34	1.28E-06	3.04E-06
Eu-154	5.39E-04	0.324	978	2.03E-04	7.10E-04
Eu-155	1.69E-04	0.101	306	6.94E-05	1.75E-04
Ra-226	1.47E-10	8.85E-08	2.67E-04	1.05E-10	1.88E-10
Ra-228	4.82E-08	2.90E-05	8.74E-02	1.93E-08	8.37E-08
Ac-227	8.86E-10	5.33E-07	1.61E-03	6.44E-10	1.08E-09
Pa-231	4.00E-09	2.40E-06	7.24E-03	2.65E-09	4.95E-09
Th-22	1.15E-09	6.93E-07	2.09E-03	5.18E-10	1.93E-09
Th-232	3.33E-09	2.00E-06	6.03E-03	1.72E-09	4.93E-09
U-232	3.02E-07	1.81E-04	0.547	1.85E-07	4.44E-07
U-233	1.16E-06	6.96E-04	2.10	7.12E-07	1.70E-06
U-234	1.74E-06	1.05E-03	3.16	1.61E-06	1.81E-06
U-235	7.31E-08	4.39E-05	0.132	6.76E-08	7.59E-08
U-236	4.41E-08	2.65E-05	7.99E-02	4.12E-08	4.55E-08
U-238	1.74E-06	1.04E-03	3.15	1.61E-06	1.80E-06
Np-237	9.02E-07	5.42E-04	1.64	6.46E-07	1.16E-06
Pu-238	2.78E-06	1.67E-03	5.04	2.48E-06	3.08E-06
Pu-239	1.47E-04	8.85E-02	267	1.39E-04	1.55E-04
Pu-240	2.17E-05	1.31E-02	39.4	2.03E-05	2.32E-05
Pu-241	1.65E-04	9.95E-02	300	1.45E-04	1.86E-04
Pu-242	7.90E-10	4.75E-07	1.43E-03	6.67E-10	9.13E-10
Am-241	5.40E-05	3.25E-02	98.0	3.97E-05	6.83E-05

Table A3-3. Historical Tank Inventory Estimate Radionuclides.[1, 2] (3 sheets)

Total Inventory Estimate					
Radiological Constituents	Ci/L	μCi/g	Ci	-95 CI (Ci/L)	+95 CI (Ci/L)
Am-243	1.63E-09	9.82E-07	2.96E-03	1.18E-09	2.10E-09
Cm-242	1.02E-07	6.12E-05	0.185	3.34E-08	1.07E-07
Cm-243	9.18E-09	5.52E-06	1.66E-02	2.66E-09	9.73E-09
Cm-244	1.03E-07	6.18E-05	0.186	3.55E-08	1.40E-07
Totals	*M*	μg/g	kg	-95 CI (M or g/L)	+95 CI (M or g/L)
Pu	2.31E-03 (g/L)	----	4.18	2.16E-03	2.45E-03
U	2.10E-02	3.00E+03	9.04E+03	1.94E-02	2.18E-02

Notes:

[1]Agnew et al. (1997a)

[2]The HTCE predictions have not been validated and should be used with caution.

A4.0 SURVEILLANCE DATA

Tank 241-S-106 surveillance includes surface-level measurements (liquid and solid) and temperature monitoring inside the tank (waste and headspace). The data provide the basis for determining tank integrity.

Liquid level measurements may indicate if there is a major leak from a tank. Solid surface-level measurements indicate physical changes and consistency of the solid layers.

A4.1 SURFACE LEVEL READINGS

The waste surface level for tank 241-S-106 was measured by a manual tape until June 1981 and by a Food Instrument Corporation gauge until June 1994. Currently, the waste level is measured by an ENRAF™ system located in riser 3. The waste level was adjusted in April and June 1982 as a result of saltwell pumping. The waste level was again adjusted in December 1993. As indicated by the solid line and boxes in Figure A4-1, a gradual increase in the tank level was observed between 1989 and December 1997. This is attributed to retained gas in the tank liquids. On November 30, 1997, the waste surface level was 461 cm (181.5 in.), as measured by the manual ENRAF™ system. Figure A4-1 shows the volume measurements as a level history graph.

A4.2 DRYWELL READINGS

Tank 241-S-106 has six drywells, with all radioactivity readings below background levels.

A4.3 INTERNAL TANK TEMPERATURES

Tank 241-S-106 contains a single thermocouple tree, located in riser 2, with 14 thermocouples. The Surveillance Analysis Computer System (SACS) has data from all 14 thermocouples. The elevations of all thermocouples on this tree are available. Temperature data, recorded from January 1991 through December 1997, were obtained from the SACS (LMHC 1997). The average temperature of the SACS data is 24.5°C (76.1°F), the minimum is 16.7°C (62.1°F), and the maximum is 31°C (87°F). The average temperature of the SACS data over the last year (January 1997 through December 1997), was 23.3°C (73.9°F), the minimum was 16.4°C (61.5°F), and the maximum was 26.6°C (79.9°F). Readings were only available from thermocouples 1 through 10 and 12 for the last year. The high temperature on January 6, 1998, was 26.1°C (79.0°F) on thermocouple 4 (located in the waste) and the minimum was 19.9°C (67.8°F) on thermocouple 10 (located in the headspace). Figure A4-2 shows a graph of the weekly high temperatures. Plots of the individual thermocouple readings can be found in Brevick et al. (1997).

A4.4 TANK 241-S-106 PHOTOGRAPHS

The March 1989 photographic montage of tank 241-S-106's interior (Brevick et al. 1997) shows a solid yellow/white saltcake surface with a large pool of dark liquid in the middle. Because no tank activities have resulted in significant change in the tank contents since the photographs were taken, this photographic montage should accurately represent the current appearance of the tank's waste.

Figure A4-1. Tank 241-S-106 Level History.

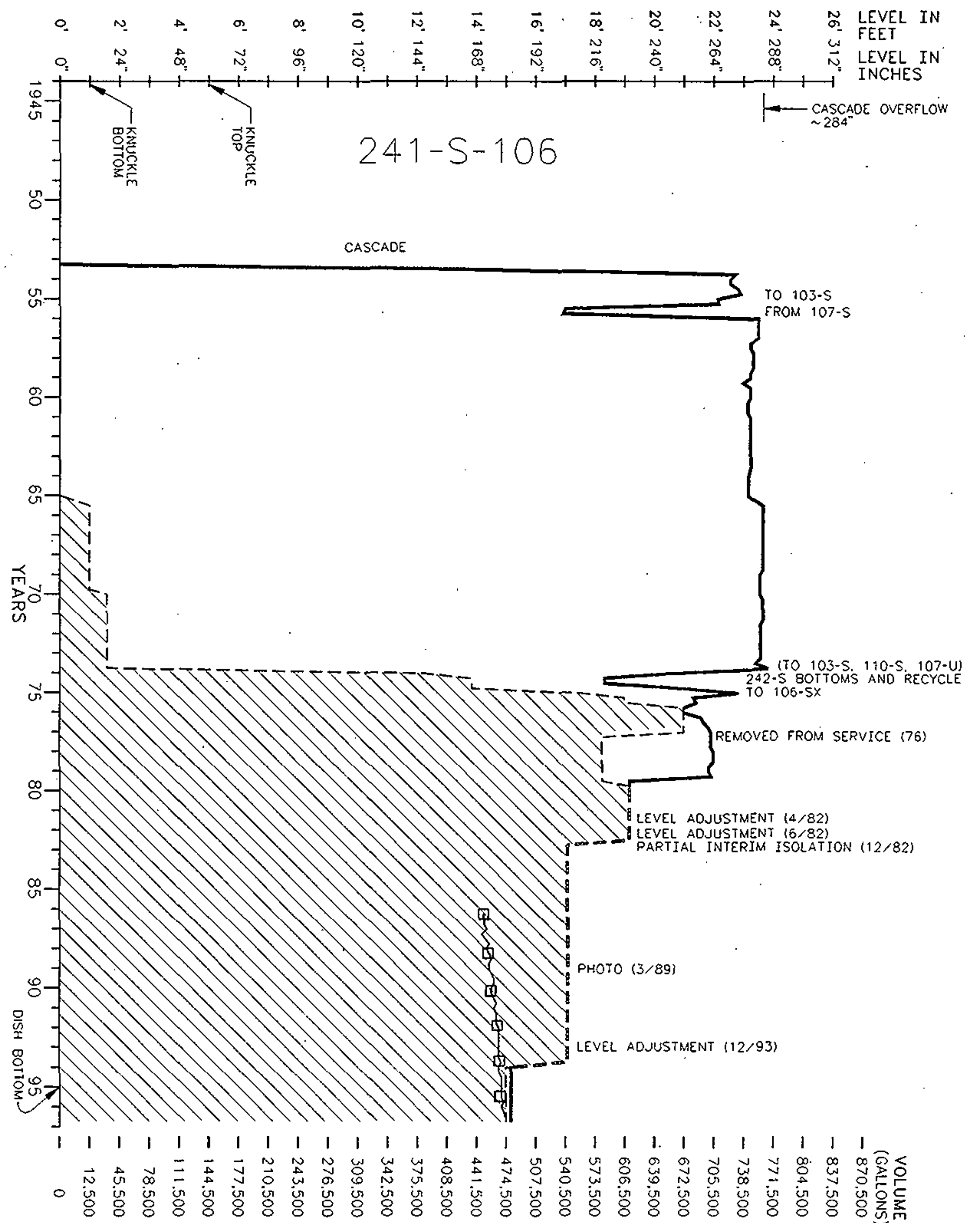
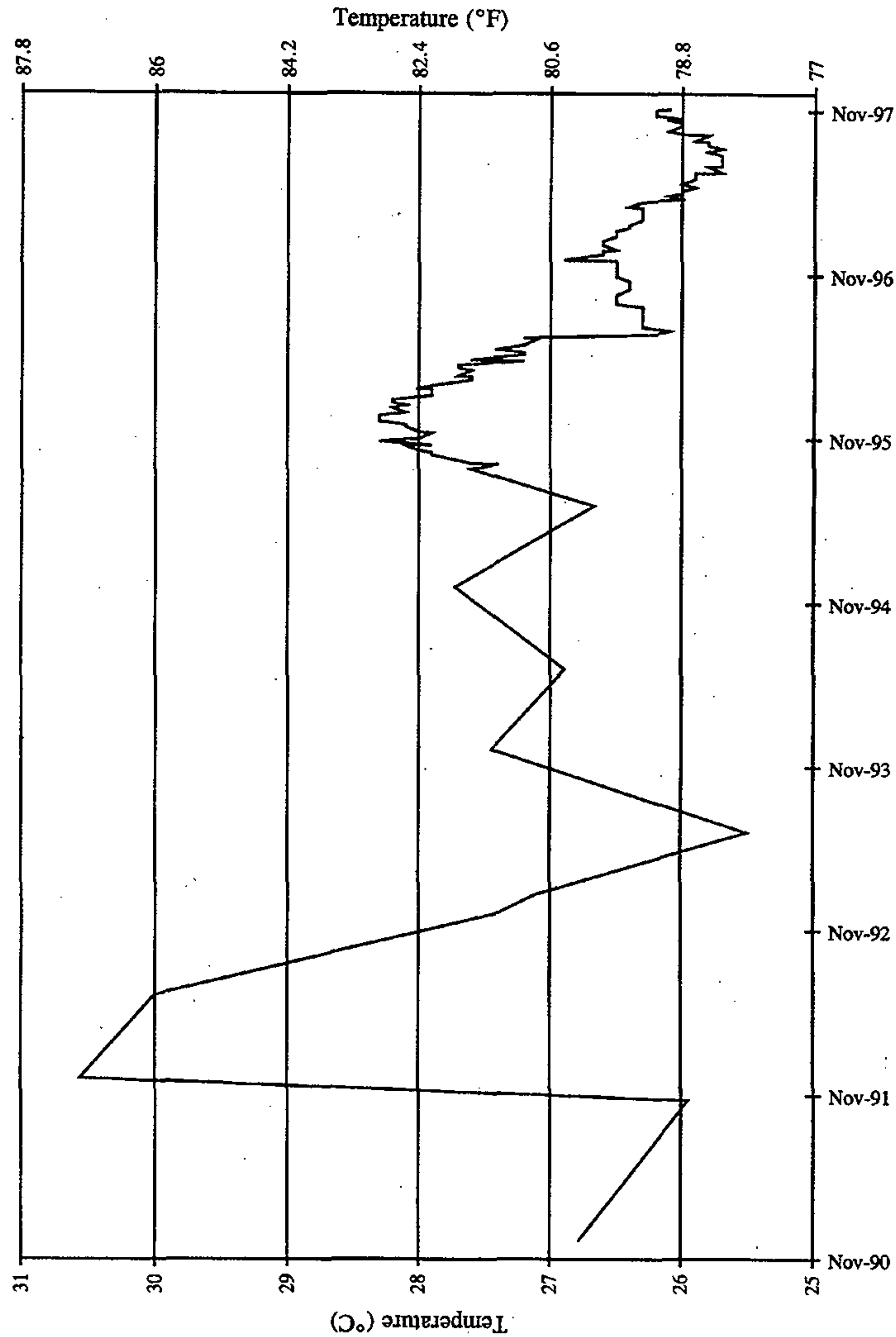


Figure A4-2. Tank 241-S-106 Weekly High Temperature Plot.



A5.0 APPENDIX A REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., P. Baca, R. A. Corbin, T. B. Duran, and K. A. Jurgensen, 1997a, *Waste Status and Transaction Record Summary: WSTRS Rev. 4*, LA-UR-97-311, Rev. 4, Los Alamos National Laboratory, Los Alamos, New Mexico.

Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Supporting Document for the Historical Tank Content Estimate for S-Tank Farm*, HNF-SD-WM-ER-323, Rev. 1, Fluor Daniel Northwest, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Ewer, K. L., J. W. Funk, R. G. Hale, G. A. Lisle, C. V. Salois, M. R. Umphrey, 1997, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Area*, HNF-SD-WM-ER-352, Rev. 1, Fluor Daniel Northwest, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Hanlon, B. M., November 1998, *Waste Tank Summary Report for Month Ending November 30, 1997*, WHC-EP-0182-116, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Leach, C. E., and S. M. Stahl, 1993, *Hanford Site Tank Farm Facilities Interim Safety Basis*, WHC-SD-WM-ISB-001, Rev .0, Westinghouse Hanford Company, Richland, Washington.

Lipnicki, J., 1997, *Waste Tank Risers Available for Sampling*, HNF-SD-WM-TI-710, Rev. 4, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

LMHC, 1997, SACS: Surveillance Analysis Computer System, In: SQL Server/Visual Basic [Mainframe], Available: Hanford Local Area Network, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Rutherford, M. J., 1949, *Specifications for Construction of Waste Disposal Facilities, 241-S, 216-S, 207-S, 200 West Area, Hanford Works*, Specification No. HW3937, General Electric Company, Richland, Washington.

Tran, T. T., 1993, *Thermocouple Status Single Shell & Double Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Vitro, 1988, "Piping Waste Tank Isolation Tank 241-S-106," Drawing H-2-73185, Rev. 4, Vitro Engineering Corporation, Richland, Washington.

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APPENDIX B

SAMPLING OF TANK 241-S-106

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APPENDIX B

SAMPLING OF TANK 241-S-106

Appendix B provides sampling and analysis information for each known sampling event for tank 241-S-106 and assesses the 1997 push mode core sample results. It includes the following.

- **Section B1.0**: Tank Sampling Overview
- **Section B2.0**: Sampling Events and Analytical Results
- **Section B3.0**: Assessments of Characterization Results from the 1997 Push Mode Core Sampling Event
- **Section B4.0**: Appendix B References

Future sampling information for tank 241-S-106 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This appendix discusses four types of sampling and analysis events for tank 241-S-106.

Push mode core samples were taken in February and March 1997 to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995), and the *Historical Model Evaluation Data Requirements* (Simpson and McCain 1997). The sampling and analyses were performed in accordance with the *Tank 241-S-106 Push Mode Core Sampling and Analysis Plan* (Buckley 1997). These analyses are discussed in Section B2.1.

The tank sampling and analysis plan (TSAP) also includes requirements to support the *Sampling Plan for Tank 241-S-106 Retained Gas Sampler Deployment* (Bates and Shekarriz 1996) and bubble retention experiments identified in the *Gas Bubble Retention and Release Studies Test Plan* (Rassat 1997). These analyses are discussed in Section B2.2

Tank headspace vapors were characterized from samples collected in June 1996 in accordance with the *Vapor Sampling and Analysis Plan* (Homi 1995). These analyses are discussed in Section B2.3.

Several historical samples were collected between September 1971 and June 1975. These sample events are discussed in Section B2.4.

B2.0 SAMPLING EVENTS

This section describes sampling events and analytical results. Tables B2-9 through B2-72 show analytical results for the push mode core sampling event and the headspace vapor sampling event, which were used to characterize current tank contents. Historical sample results are provided in Section B2.4.

B2.1 DESCRIPTION OF 1997 PUSH CORE SAMPLING EVENT

A vertical profile is used to satisfy the safety screening DQO (Dukelow et al. 1995). Safety screening analyses include: total alpha activity to determine criticality, DSC to ascertain the fuel energy value, and thermogravimetric analysis (TGA) to obtain the total moisture content. In addition, combustible gas meter readings in the tank headspace were performed to measure tank headspace flammability. The safety screening DQO also requires bulk density measurements.

Tank 241-S-106 also was evaluated against the historical model requirements (Simpson and McCain 1997). The specified gateway analytes to evaluate the tank layer model (TLM) for this tank are chromium, sodium, aluminum, nitrate, carbonate, sulfate, and water. Historical model analyses include: DSC, TGA, inductively coupled plasma (ICP), and ion chromatography (IC). The full range of analytes is required for both ICP and IC analyses.

Table B2-1 summarizes the sampling and analytical requirements for applicable issues.

Description of Core 183. Ten push mode core segments were removed from tank 241-S-106, riser 8 between February 12, 1997 and February 21, 1997. Segments were received by the 222-S Laboratory between February 14, 1997 and February 24, 1997. Table B2-2 (a, b, and c) summarizes the extrusion information.

Selected segments (2, 6, and 10) were sampled using the retained gas sampler and extruded by the Process Chemistry and Statistical Analysis Group. The sample for segment 2 was lost because the valve was leaking when the sampler was being prepared for the extrusion.

Description of Core 184 . Ten push mode core segments were scheduled to be removed from tank 241-S-106, riser 7 but because of problems encountered during sampling, only six segments were obtained. Three attempts were made to collect a full segment at the depth for segment 6. These were identified as segments 6, 6R, and 6RA. A total of eight samples were collected between February 24, 1997 and March 17, 1997. Segments were received by the 222-S Laboratory between February 25, 1997 and March 18, 1997. Table B2-2 (a, b, and c) summarizes the extrusion information.

Selected segments (3 and 5) were sampled using the retained gas sampler.

Table B2-1. Integrated Data Quality Objective Requirements for Tank 241-S-106.[1]

Sampling Event	Applicable Issues	Sampling Requirements	Analytical Requirements
Push mode core sampling	Safety screening - Energetics - Moisture content - Total alpha - Flammable gas Dukelow et al. (1995) Flammable gas Cash (1996), Bauer and Jackson (1997). Organic complexants Schreiber (1997) Historical Simpson and McCain (1997)	Core samples from a minimum of two risers separated radially to the maximum extent possible. Combustible gas measurement	Flammability, energetics, moisture, total alpha activity, density, anions, cations, radionuclides, TOC, separable organics, physical properties, TIC, pH, Cr(VI)
Vapor sampling	Hazardous vapor Osborne and Buckley (1995) Organic solvents Meacham et al. (1997)	Steel canisters, triple sorbent traps, sorbent trap systems	Flammable gas, organic vapors, permanent gases

Note:

TIC = total inorganic carbon

[1]Brown et al. (1997)

Description of Core 187. Because two full cores were not obtained from the first two risers, a third core consisting of 13 push mode core segments was scheduled to be removed from tank 241-S-106, riser 14. Additional sampling problems were encountered, and only three segments were obtained. Two attempts were made to collect a full segment for segments 1 and 2. These were identified as segments 1, 1R, 2, and 2R. A total of five samples were collected between March 19, 1997 and March 21, 1997. Segments were received by the 222-S Laboratory between March 21, 1997 and March 24, 1997. Table B2-2 (a, b, and c) summarizes the extrusion information.

Table B2-2a. Sample Receipt and Extrusion Information for 241-S-106, Riser 8, Core 183. (2 sheets)

Sample Id	Segment	Date Sampled[1]	Date Received	Date Extruded	Inches Extruded[2]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
97-26	1	2/12/97	2/14/97	2/27/97	0.0	412.8-Drainable	0.0	An unmeasurable amount of white crystalline solids was collected with the drainable liquid. The liquid was yellow in color and clear. Collected 310 mL of liquid. No organic layer was observed.
97-27	2	2/12/97	2/24/97	N/A	N/A	N/A	N/A	This segment was sampled using the retained gas sampler and extruded by the Process Chemistry Group.
97-28	3	2/13/97	2/14/97	2/27/97	0.0	426.9-Drainable	0.0	An unmeasurable amount of white crystalline solids was collected with the drainable liquid. The liquid was yellow in color and opaque. Collected 310 mL of liquid. No organic layer was observed.
97-29	4	2/13/97	2/14/97	2/28/97	1.0	340.7-Drainable	21.6-Lower half	The solids were dark green in color and resembled a wet salt. The liquid was dark green in color and opaque. Collected 250 mL of liquid. No organic layer was observed.
97-30	5	2/18/97	2/19/97	2/28/97	2.0	340.1-Drainable	34.6-Lower half	There were both dark green and white solids that resembled a wet salt. The different colored solids could not be separated; therefore, the sample was nonhomogeneous. The liquid was yellow-green in color and opaque. Collected 250 mL of liquid. No organic layer was observed.
97-31	6	2/18/97	2/24/97	N/A	N/A	N/A	N/A	This segment was sampled using the RGS system and extruded by the Process Chemistry Group.

Table B2-2a. Sample Receipt and Extrusion Information for 241-S-106, Riser 8, Core 183. (2 sheets)

Sample Id	Segment	Date Sampled[1]	Date Received	Date Extruded	Inches Extruded[2]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
97-32	7	2/18/97	2/19/97	2/28/97	3.0	285.7-Drainable	67.0-Lower half	The solids were dark green in color and resembled a wet salt. The liquid was dark green in color and opaque. Collected 190 mL of liquid. No organic layer was observed.
97-33	8	2/21/97	2/24/97	3/5/97	19.0	0.0	99.1-Upper half 79.2-Lower half 109.5-Upper half for GBR[3] 139.8-Lower half for GBR[3]	The solids were green-gray in color and resembled a wet salt.
97-34	9	2/21/97	2/24/97	3/5/97	19.0	0.0	78.2-Upper half 83.9-Lower half 141.0-Upper half for GBR[3] 134.4-Lower half for GBR[3]	The solids were green-gray in color and resembled a wet salt.
97-35	10	2/21/97	2/24/97	N/A	N/A	N/A	N/A	This segment was sampled using the RGS system and extruded by the Process Chemistry Group. 1,500 mL LiBr was added.

Notes:

N/A = Information was not available or not applicable

[1]Dates are in the mm/dd/yy format.
[2]Number of inches extruded is approximate.
[3]GBR refers to gas bubble retention and release studies.

Table B2-2b. Sample Receipt and Extrusion Information for 241-S-106, Riser 7, Core 184. (3 sheets)

Sample Id	Segment	Date Sampled[1]	Date Received	Date Extruded	Inches Extruded[2]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
97-36	1	2/24/97	2/25/97	3/20/97	0.0	344.3-Drainable	0.0	An unmeasurable amount of white crystalline solids was collected with the drainable liquid. The liquid was yellow in color and clear. Collected 250 mL of liquid. No organic layer was observed.
97-37	2	2/24/97	2/28/97	3/6/97	3.0	303.3-Drainable	78.7-Lower half	The solids were black, white and green in color and resembled a salt slurry. The different colored solids could not be separated. The sample was nonhomogeneous. The liquid was green in color and opaque. Collected 230 mL of liquid. No organic layer was observed. LiBr was added.
97-38	3	2/24/97	2/25/97	N/A	N/A	N/A	N/A	This segment was sampled using the RGS system and extruded by the Process Chemistry Group. LiBr was used during sampling.
97-39	4	2/25/97	2/25/97	3/7/97	19.0	0.0	89.6-Upper half 90.6-Lower half 145.7-Upper half for GBR[3] 100.9-Lower half for GBR[3]	The upper 24.1 cm (9.5 in.) of solid were dark gray in color and resembled a wet salt. This upper portion had some large, very hard salt crystals mixed with the slushier wet salt. The sample was nonhomogeneous. The lower 24.1 cm (9.5 in.) of solid were green-gray in color and resembled a moist salt. 1,500 mL LiBr was used during sampling.
97-40	5	2/25/97	2/25/97	N/A	N/A	N/A	N/A	This segment was sampled using the RGS system and extruded by the Process Chemistry Group. 1,500 mL LiBr was used during sampling.

Table B2-2b. Sample Receipt and Extrusion Information for 241-S-106, Riser 7, Core 184. (3 sheets)

Sample Id	Segment	Date Sampled[1]	Date Received	Date Extruded	Inches Extruded[2]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
97-41	6	3/12/97	3/8/97	3/20/97	3.0	22.9-Liner 202.0-Drainable	70.8-Upper half 31.4-Lower half	The upper 5.1 cm (2 in.) of solids were dark gray in color and resembled a salt slurry. The lower 2.5 cm (1 in.) of solids was green-gray in color and resembled a salt slurry. The liner liquid was yellow in color and clear; the drainable liquid was dark green and opaque. Collected 30 mL of liner liquid and 140 mL of drainable liquid. No organic layer was observed. 1,500 mL LiBr was used during sampling.
97-41R	6R	3/14/97	3/18/97	3/20/97	3.0	151.6-Liner	157.4-Lower half	The solids were green-gray in color and resembled a wet salt. The liner liquid was yellow in color and clear. An unmeasurable amount of drainable liquid, dark green and opaque, was collected with the solids and the sample was nonhomogeneous. Collected 150 mL of liner liquid. No organic layer was observed. 6,000 mL LiBr was used during sampling.
97-41RA	6RA	3/17/97	3/18/97	3/24/97	1.0	211.3-Liner 21.7-Drainable	20.2-Lower half	The solids were green-gray in color and resembled a salt slurry. The liner liquid was yellow in color and opaque; the drainable liquid was green and opaque. Collected 210 mL of liner liquid and 15 mL of drainable liquid. No organic layer was observed.

Table B2-2b. Sample Receipt and Extrusion Information for 241-S-106, Riser 7, Core 184. (3 sheets)

Sample Id	Segment	Date Sampled[1]	Date Received	Date Extruded	Inches Extruded[2]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
LiBr sample	LiBr	3/3/97	3/3/97	N/A	N/A	125 mL	N/A	LiBr blank.
Field blank	Blank	3/3/97	3/18/97	3/20/97	N/A	267.9 - Drainable	N/A	Liquid was clear and colorless. Collected 310 mL of liquid.

Notes:

N/A = Information was not available or not applicable.

[1]Dates are in the mm/dd/yy format.
[2]Number of inches extruded is approximate.
[3]GBR refers to gas bubble retention and release studies.

Table B2-2c. Sample Receipt and Extrusion Information for 241-S-106, Riser 14, Core 187.

Sample Id	Segment	Date Sampled[1]	Date Received	Date Extruded	Inches Extruded[2]	Liquid Recovered (g)	Solids Recovered (g)	Sample Description
97-050	1	3/19/97	3/21/97	3/26/97	0.0	12.1-Liner	0.0	There were no liquids or solids in the sampler. Collected 30 mL of liner liquid. LiBr was used during sampling.
97-50R	1R	3/21/97	3/24/97	3/26/97	0.0	36.0-Liner	0.0	There were no liquids or solids in the sampler. Collected 55 mL of liner liquid.
97-051	2	3/20/97	3/21/97	N/A	N/A	N/A	N/A	This segment was sampled using the RGS system and extruded by the Process Chemistry Group.
97-051R	2R	3/21/97	3/24/97	3/26/97	0.0	0.0	0.0	There were no liquids or solids in the sampler. LiBr was used during sampling.
97-052	3	3/21/97	3/24/97	3/27/97	2.0	0.0	14.6-Lower half	The solids were gray and white in color and resembled a very dry crumbly salt. LiBr was used during sampling.

Notes:

N/A = Information was not available or not applicable.

[1]Dates are in the mm/dd/yy format.
[2]Number of inches extruded is approximate.

Segment 2 was sampled using the retained gas sampler and was scheduled to be extruded. However, because the integrity of the sample was compromised by an open sampler valve, the sample was archived and did not undergo retained gas sampling analysis.

Field Blank. A field blank was provided to the 222-S Laboratory with core 184. It underwent the same analyses as the drainable liquid as indicated in the tank sampling and analysis plan (Buckley 1997).

Hydrostatic Head Fluid. A sample of the hydrostatic head fluid lithium bromide solution were provided with core 184 and was analyzed by IC and ICP.

B2.1.1 Sample Handling

The push mode samples were shipped to the 222-S Laboratory for subsampling and analysis. Samples were assigned LABCORE numbers and were subjected to visual inspection for color, clarity, and solids content. The radiation dose rate on contact was also measured. Drainable liquid (and liner liquid, when present in sufficient amount) was collected and clarified by centrifugation. Segments containing solids were divided into upper and lower half segments and were also divided longitudinally to provide material for the gas bubble retention and release studies. No core composites were created because there was insufficient solid material from any of the three cores to generate a composite that would represent tank contents. Sample extrusion and subsampling for the three cores is presented in Table B2-2 (a, b, and c) (Esch 1997).

B2.1.2 Performance of Sample Analysis

Obtaining reproducible results with this non-homogeneous material was difficult and may have been responsible for the large relative percent difference (RPD) between the sample and duplicate measurements for some analyses.

Table B2-3 identifies and correlates the samples (and subsamples) with the analyses that were performed on them.

Table B2-3. Tank 241-S-106 Sample Analysis Summary. (4 sheets)

Sample Identification	Sample Portion	Sample Number	Analyses
Core 183:1	Drainable liquid	S97T000276	Furnace oxidation (TOC), TIC/TOC, DSC, TGA, SpG, IC
		S97T000277	Alpha, ICP
Core 183:3	Drainable liquid	S97T000283	Furnace oxidation (TOC), TIC/TOC, DSC, TGA, SpG, IC
		S97T000287	Alpha, ICP
Core 183:4	Drainable liquid	S97T000284	Furnace oxidation (TOC), TIC/TOC, TGA, SpG, DSC, IC
		S97T000288	Alpha, ICP
	Lower half	S97T000298	DSC,TGA, TIC/TOC
		S97T000304	Alpha, GEA
		S97T00307 S97T00686	ICP
		S97T00310	IC
Core 183:5	Drainable liquid	S97T000285	Furnace oxidation (TOC), TIC/TOC, TGA, SpG, DSC, IC
		S97T00289	Alpha, ICP
	Lower half	S97T00299	DSC, TGA, TIC/TOC
		S97T00305	Alpha, GEA, Beta, ^{90}Sr, Total U
		S97T00308	ICP
		S97T00311	IC

Table B2-3. Tank 241-S-106 Sample Analysis Summary. (4 sheets)

Sample Identification	Sample Portion	Sample Number	Analyses
Core 183:7	Drainable liquid	S97T000286	Furnace oxidation (TOC), TIC/TOC, TGA, SpG, DSC, IC
		S97T000290	Alpha, ICP
	Upper half	S97T00300	DSC, TGA, TIC/TOC
		S97T00303	Bulk density
		S97T00306	Alpha, GEA
		S97T00309 S97T00685	ICP
		S97T00312 S97T00683	IC
Core 183:8	Upper half	S97T000316	Grav% water, TIC/TOC, TGA, DSC
		S97T000318	GEA
		S97T000319	ICP
		S97T000320	IC
	Lower half	S97T00321	Bulk density
		S97T00324	Grav% water, TIC/TOC, TGA, DSC
		S97T00330	Alpha, GEA
		S97T00333	ICP
		S97T00336 S97T00684	IC
Core 183:9	Upper half	S97T000325	Grav% water, TIC/TOC, TGA, DSC
		S97T000331	GEA
		S97T000334	ICP
		S97T000337	IC
	Lower half	S97T00323	Bulk density
		S97T000326	Grav% water, TIC/TOC, TGA, DSC
		S97T000332	Alpha, GEA
		S97T000335	ICP
		S97T000338	IC

Table B2-3. Tank 241-S-106 Sample Analysis Summary. (4 sheets)

Sample Identification	Sample Portion	Sample Number	Analyses
Core 184:1	Drainable liquid	S97T000340	Furnace oxidation (TOC), TIC/TOC, TGA, SpG, DSC, IC
		S97T000341	Alpha, ICP
Core 184:2	Drainable liquid	S97T000350	Furnace oxidation (TOC), TIC/TOC, TGA, SpG, DSC, IC
		S97T000351	Alpha rad, ICP
	Lower half	S97T00344	DSC, TGA, TIC/TOC
		S97T00346	Alpha, GEA
		S97T00347	ICP
		S97T00348	IC
Core 184:4	Upper half	S97T00354	Grav% water, TIC/TOC, TGA,DSC
		S97T00356	GEA
		S97T00357	ICP
		S97T00358	IC
	Lower half	S97T00359	Bulk density
		S97T00360	Grav% water, TIC/TOC, TGA, DSC
		S97T00362	Alpha, GEA
		S97T00363	ICP
		S97T00364	IC
Core 184:6	Drainable liquid	S97T000420	DSC/TGA, SpG, IC
		S97T000421	Alpha, TIC/TOC, ICP
	Liner liquid	S97T000424	ICP, IC
	Upper half	S97T000408	Grav% water, TIC/TOC, TGA, DSC
		S97T000410	Alpha, GEA, Beta, ^{90}Sr, Total U
		S97T000412	IC
		S97T001370	ICP

Table B2-3. Tank 241-S-106 Sample Analysis Summary. (4 sheets)

Sample Identification	Sample Portion	Sample Number	Analyses
Core 184:6 (Cont'd)	Lower half	S97T000414	Grav% water, TIC/TOC, TGA, DSC
		S97T000416	Alpha, GEA
		S97T000417	ICP
		S97T000418	IC
Core 184:6R	Lower half	S97T000425	Bulk density
		S97T000426	Grav% water, TIC/TOC, DSC/TGA, TGA
		S97T000428	Alpha, GEA
		S97T000429	ICP
		S97T000430	IC
Core 184:6R	Liner liquid	S97T000432	ICP, IC
Core 184:6RA	Drainable liquid	S97T000445	Alpha rad, TIC/TOC, DSC/TGA, SpG, ICP, IC
	Liner liquid	S97T000447	ICP, IC
	Lower half	S97T000439	Grav% water, TIC/TOC, DSC/TGA, TGA
		S97T000441	Alpha, GEA
		S97T000442	ICP
		S97T000443	IC

Notes:

GEA = gamma energy analysis
Grav% = gravimetric percent water
SpG = specific gravity

All reported analyses were performed according to approved laboratory procedures. Table B2-4 lists the field and 222-S Laboratory analytical procedures which were used to analyze the push mode samples. Abbreviations for analyses are defined in the table notes.

Table B2-4. Analytical Procedures.

Analysis	Preparation Procedure	Analysis Procedure
Bulk density	Direct analysis	LO-160-103 Rev. B-0
DSC	Direct analysis	LA-514-113 Rev. C-1 LA-514-114 Rev. D-0
TGA	Direct analysis	LA-514-114 Rev. D-0 LA-560-112 Rev. C-0 and C-1
Grav. % water	Direct analysis	LA-564-101 Rev. G-0
Sp.G.	Direct analyses	LA-510-112 Rev. C-3 and D-1
IC	Liquid - direct analysis Solid - LA-504-101 Rev. E-0[1]	LA-533-105 Rev. D-1
ICP	Liquid - acid dilution Solid - LA-505-163 Rev. A-0[2]	LA-505-161 Rev. B-1 and C-1
TOC - Furnace oxidation	Direct analysis - liquid	LA-344-105 Rev. E-0
TOC - Persulfate oxidation	Direct analysis - liquid & solid	LA-342-100 Rev. E-0
TIC	Direct analysis	LA-342-100 Rev. E-0
Total uranium	LA-549-141 Rev. F-0[3]	LA-925-009 Rev. A-1
Radionuclide Analyses		
Total alpha	Liquid - direct analysis Solid - LA-549-141 Rev. F-0[3]	LA-508-101 Rev. F-0 and G-0
Total beta	LA-549-141 Rev. F-0[3]	LA-508-101 Rev. G-0
GEA	LA-549-141 Rev. F-0[3]	LA-548-121 Rev. F-0
^{90}Sr	LA-549-141 Rev. F-0[3]	LA-220-101 Rev. E-1
Flammable Gas		
Combustible gas analyzer	Direct analysis	WHC-IP-0030, IH 1.4 and IH 2.1[4]

Notes:

grav. % water = gravimetric percent water

[1]Water digestion procedure
[2]Acid digestion procedure
[3]Fusion digestion procedure
[4]WHC (1992) Safety Department Administrative Manuals, Westinghouse Hanford Company, Richland, Washington:
IH 1.4, Industrial Hygiene Direct Reading Instrument Survey
IH 2.1, Standard Operating Procedure, MSA Model 260 Combustible Gas and Oxygen Analyzer

B2.1.3 Discussion of Analytical Results

This section summarizes the analytical results associated with the February/March 1997 push mode samples. Table B2-5 indicates which summary result tables are associated with each analyte.

Table B2-5. Table of Summary Analytical Tables.

Analysis	Table Number(s)
Metals by Inductively Coupled Plasma/Emission Spectrometry	B2-7through B2[illegible]
Total Uranium by Laser Fluorimetry	B2-44
Anions by Ion Chromatography	B2-45 through B2-52
Bulk Density	B2-53
Energetics by Differential Scanning Calorimetry	B2-54
Percent Water by Percent Solids	B2-55
Percent Water by Thermogravimetric Analysis	B2-56
Specific Gravity	B2-57
Total Alpha by Proportional Counter	B2-58
Total Beta by Proportional Counter	B2-59
Gamma Energy Analysis	B2-60 through B2-64
$^{89/90}$Sr by Separation/ß Counting	B2-65
Total Organic Carbon by Furnace Oxidation	B2-66
Total Organic Carbon by Persulfate Oxidation/Coulometry	B2-67
Total Inorganic Carbon by Persulfate Oxidation	B2-68

The quality control (QC) parameters assessed in conjunction with tank 241-S-106 samples were standard recoveries, spike recoveries (and serial dilutions), duplicate analyses (RPDs), and blanks. The QC criteria are specified in the sampling and analysis plan (Buckley 1997). Sample and duplicate analytical results, in which any QC parameter was outside the acceptance limits, are flagged with qualifiers in the sample mean column of the following data summary tables with an a, b, c, d, e, f, g, h, I, or j as follows.

- "a" indicates that the standard recovery was below the sampling and analysis plan QC range.

- "b" indicates that the standard recovery was above the sampling and analysis plan QC range.

- "c" indicates that the spike recovery was below the QC range.
- "d" indicates that the spike recovery was above the QC range.
- "e" indicates that the RPD was greater than the QC limit range.
- "f" indicates that there was blank contamination.
- "g" indicates that this is a tentatively identified compound.
- "h" indicates that the serial dilution exceeds the acceptance limit.
- "I" indicates that the serial dilution met the acceptance limit.
- "j" indicates that variability in analytical results was attributed to proximity of the analyte concentration to the detection limit.

In the analytical tables in this section, the "mean" is the average of the result and duplicate value. All values, including those below the detection level (denoted by "<") were averaged. If both sample and duplicate values were non-detected or if one value was detected while the other was not, the mean is expressed as a non-detected value. If both values were detected, the mean is expressed as a detected value.

B2.1.3.1 Total Alpha Activity. The total alpha activity analyses were performed in duplicate on direct subsamples for the drainable liquids. Lower half segment solid subsamples were prepared for analysis by performing a fusion digest in duplicate. The maximum total alpha result was 0.11 μCi/g.

B2.1.3.2 Total Beta Activity. In support of the historical DQO (Simpson and McCain 1997), two half segments were analyzed for total beta activity. These were core 183, segment 5 lower half solids (S97T000305) and core 184, segment 6 upper half solids (S97T000410).

Total beta activity analyses were performed in duplicate on the fusion digest sample. The total beta results were 126 μCi/g for segment 6 and 143 μCi/g for segment 5.

B2.1.3.3 Strontium-89/90. In support of the historical DQO (Simpson and McCain 1997), two half segments were analyzed for $^{89/90}$Sr. These were core 183, segment 5 lower half solids (S97T000305) and core 184, segment 6 upper half solids (S97T000410). Analytical results were 1.98 μCi/g and 27.9 μCi/g, respectively. The subsamples were prepared for analysis by a fusion digestion.

B2.1.3.4 Gamma Energy Analysis. This analysis was performed for ^{241}Am, ^{137}Cs, ^{60}Co, ^{154}Eu, and ^{155}Eu on solids from every half segment. The subsamples were prepared for analysis by a fusion digestion. Only ^{137}Cs was measured at values above detection levels. Results for ^{137}Cs ranged from 63 to 146 μCi/g.

B2.1.3.5 Thermogravimetric Analysis, Gravimetric Percent Water, and Infrared Percent Water. Thermogravimetric analysis measures the mass of a sample as its temperature is increased at a constant rate. Nitrogen is passed over the sample during heating to remove any released gases. A decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample, through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 150 to 200 °C [300 to 390 °F]) is caused by water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions can often be differentiated by inflection points as well.

The TGA analyses were performed in duplicate on direct subsamples. Typically the results for TGA analysis are determined by summing the weight loss steps that are completed below 250 °C (482 °F). However, the final weight loss step for 15 percent of the results began below 250 °C (482 °F) but continued out to 270° C (518 °F) and were included in the determination of the result. No weight loss was observed above this temperature. Approximately 57 percent of the results were determined by summing the weight loss from two or more steps. Percent water measurements by TGA ranged from 28.3 to 51.4 percent for solids samples and 52.1 to 55.6 percent for drainable liquids.

The gravimetric percent water analyses were performed in duplicate on direct solid subsamples. Results ranged from 24.1 to 37 percent. This analysis was performed only on segments with sufficient material to determine the percent water by near-infrared spectroscopy. Although no QC criteria were specified for gravimetric analysis, the standard recoveries and RPDs were within the limits specified for TGA. These results agreed reasonably well with the TGA results except for samples S97T000360, S97T000414, and S97T000408.

Research on a near infrared (NIR) spectroscopy procedure to determine percent water in sludge and saltcake was also performed as directed in the sampling and analysis plan (Buckley 1997). Many sample results were out of range for the near infrared instrument, and there was generally poor agreement between the near infrared results and the TGA and gravimetric moisture results (Crawford 1997).

B2.1.3.6 Differential Scanning Calorimetry. In the DSC analyses, heat absorbed or emitted by substances was measured while the sample was heated at a constant rate. A nitrogen purge was applied to remove oxygen from the analytical system. The onset temperature for an endothermic or exothermic event was determined graphically.

The DSC analyses were performed in duplicate on direct subsamples. The exothermic energy based on dry weight of subsample was calculated for all subsamples. The average of the TGA result for each subsample was used in the dry weight correction for that subsample. The standard recoveries for this analysis were within the required limits.

Six of 24 subsamples submitted for the DSC analysis exceeded the notification limit of 480 J/g (dry weight basis). Appropriate notifications were made.

The Safety Program requested the reanalysis of the two samples exhibiting the highest exotherms, core 183, segment 1 drainable liquid (S97T000276) and core 183, segment 4 lower half solids (S97T000298). These samples were analyzed two additional times in lieu of performing the reactive system screening tool (RSST) analysis as required by the sampling and analysis plan (Buckley 1997) because the RSST procedure was not available at the 222-S Laboratory at that time. For both samples, the second analysis results did not exceed the notification limit, and the third analysis showed no exotherm.

In some cases, because of instrument uncertainty, high endotherms may have been identified as exotherms to "err on the conservative side." High exotherms were compared with TOC energy equivalent calculations and found to be suspect (Esch 1997).

Subsamples that had high RPDs and exceeded the notification limit were selected for reanalysis: core 183, segment 5 drainable liquid (S97T000285), core 183, segment 7 drainable liquid (S97T000286), and core 183, segment 7 lower half solids (S97T000300). The second analysis result for sample S97T000300 did not exceed the notification limit. However, the dry calculated DSC results for the two drainable liquids did exceed the notification limit for both analysis runs. The results did not improve the QC parameters. No further reruns were requested.

B2.1.3.7 Specific Gravity and Bulk Density. Bulk density was performed on the solid subsamples as required by the sampling and analysis plan (Buckley 1997). There were insufficient solids to determine bulk density for core 183, segments 4 and 5, and core 184, segments 2, 6, and 6RA. The results of the bulk density test ranged from 1.58 g/mL to 1.92 g/mL. The highest bulk density of 1.92 g/mL was used to calculate the solid total alpha activity action limit for the tank.

The specific gravity results for the liquid samples ranged from 1.39 to 1.52. The standard recoveries and RPDs for this analysis were within the required limits.

B2.1.3.8 Inductively Coupled Plasma Spectrophotometry. Solid samples were prepared by acid digest, and liquid samples were prepared by acid dilution.

The review of QC was limited to specific analytes listed in Table B2-6, which depended on individual DQO requirements. All other ICP analyte results were considered "opportunistic" and did not have program-specified QC acceptance criteria. Therefore, any anomalies in those results were not discussed in this report. However, these "opportunistic" results were shown in the summary data tables with qualifier flags, which assume the same quality control limits as specified for the required analytes.

Table B2-6. Required Inductively Coupled Plasma Analytes By Tank Issue.

Issue	Required Analytes
Safety screening	Li - primary on all half segments
Organic	Al, Bi, Ca, Fe, P, Na - secondary on all half segments. DSC exceeded notification
Historical	Al, Cr, Na - fingerprint on all half segments; Full ICP - Core 183, segment 5, lower half (S97T000308) Core 184, segment 6, upper half (S97T001370)

All laboratory control standard recoveries were within the requested limits of 80 to 120 percent except for the following: silicon for all solid samples and iron, selenium, thallium, titanium, and zinc for six solid samples.

In addition to the matrix spike and post digestion spike analyses, a serial dilution analysis was performed by diluting the sample by an additional five-fold. The serial dilution is a more appropriate measure of accuracy of the analysis when the sample concentration is more than 50 times the instrument detection limit. For acceptable performance, the percent difference between the serial dilution value multiplied by the five-fold dilution factor and the undiluted results must be $\leq$10 percent. Serial dilution results were $<$10 percent for all required analytes. For specific dilution results, refer to Esch (1997). The primary metals observed were aluminum and sodium. Nineteen of the ICP analyte concentrations were lower than detection levels. Lithium concentrations were lower than 100 μg/g except for core 184, segment 6RA, indicating that there was no significant hydrostatic head fluid intrusion.

B2.1.3.9 Ion Chromatography (Anions). The IC analysis was performed on direct aliquots for the drainable liquids. The centrifuged solids were prepared for analysis by a water digestion. Bromide (Br^-) analysis was required on the liquids and solids by the safety screening DQO (Dukelow et al. 1995). Nitrate (NO_3^-) and sulfate (SO_4^{-2}) fingerprint analyses were required on the solids by the historical DQO (Simpson and McCain 1997). All other anion results are considered "opportunistic" and do not have program-defined QC parameters. Qualifier flags have been applied to the opportunistic analytical data in the summary tables for which no quality control acceptance limits were specified in the sampling and analysis plan (Buckley 1997). This qualification of data assumes that the quality control limits would have been the same as for the required analytes.

All IC analyte concentrations exceeded detection levels. The primary analytes were nitrate and nitrite. Bromide concentrations ranged from "lower than detect" values to 1,880 μg/g in solids and up to 4,540 μg/mL in liquids. As for the lithium value, the highest bromide value was observed for core 184, segment 6RA.

B2.1.3.10 Total Uranium. In support of the historical DQO (Simpson and McCain 1997), two half segments were analyzed for total uranium by laser flourimetry. The total uranium analysis was performed in duplicate on the fusion digest. Samples analyzed were core 183, segment 5 lower half solids (S97T000305) and core 184, segment 6 upper half solids (S97T000410). Uranium values for the two samples were 84.4 μg/g and 375 μg/g, respectively.

B2.1.3.11 Total Inorganic Carbon. Analyses by persulfate oxidation/coulometry were performed in duplicate on the direct subsamples for every half segment and all of the drainable liquids. Total inorganic carbon TIC values ranged from 1,600 μgC/g to 19,900 μgC/g for solids and from 1,580 μg/mL to 5,650 μg/mL for drainable liquids.

B2.1.3.12 Total Organic Carbon. All TOC analytical results were lower than the notification limit of three weight percent TOC on a dry weight basis. Total organic carbon analyses by persulfate oxidation/coulometry were performed in duplicate on the direct subsamples for every half segment and all drainable liquids.

Triplicate analyses were performed on seven subsamples because of the high total inorganic carbon RPDs. The results indicate that the variability may be related to sample inhomogeneity.

Total organic carbon analyses by furnace oxidation/coulometry were performed only on direct liquid aliquots. Two samples had high RPDs on the first analysis: core 183, segment 1 drainable liquid (S97T000276) (40.0 percent) and core 183, segment 5 drainable liquid (S97T000285) (21.7 percent). These were reanalyzed. The rerun results of 1,440 and 1,900 μgC/mL for S97T000276 and S97T000285, respectively, are an additional indication of the variability of the results.

B2.1.4 Analytical Result Summary Tables for the 1997 Push Mode Core Samples.

Table B2-7. Tank 241-S-106 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	18,200	19,300	18,800
S97T000686		Lower half	18,000	19,600	18,800
S97T000308	183:5	Lower half	19,500	20,800	20,200
S97T000309	183:7	Lower half	16,000	16,100	16,100[QC:d,i]
S97T000685		Lower half	15,100	14,100	14,600[QC:d,i]
S97T000319	183:8	Upper half	19,900	19,500	19,700
S97T000333		Lower half	16,400	16,400	16,400
S97T000334	183:9	Upper half	18,500	20,500	19,500
S97T000335		Lower half	36,200	38,500	37,400[QC:c,i]
S97T000347	184:2	Lower half	9,840	9,680	9,760
S97T000357	184:4	Upper half	14,800	15,000	14,900
S97T000363		Lower half	12,100	13,300	12,700
S97T001370	184:6	Upper half	11,500	11,300	11,400
S97T000417		Lower half	8,120	7,370	7,750[QC:d,i]
S97T000429	184:6R	Lower half	10,300	10,900	10,600[QC:c,i]
S97T000442	184:6RA	Lower half	22,600	20,200	21,400
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	32,700	32,200	32,500[QC:c,i]
S97T000287	183:3	Drainable liquid	35,900	39,000	37,500
S97T000288	183:4	Drainable liquid	41,200	40,600	40,900
S97T000289	183:5	Drainable liquid	48,300	45,600	47,000
S97T000290	183:7	Drainable liquid	39,400	39,400	39,400[QC:c,i]
S97T000341	184:1	Drainable liquid	33,600	35,900	34,800[QC:c,i]
S97T000351	184:2	Drainable liquid	34,500	32,100	33,300
S97T000421	184:6	Drainable liquid	45,000	43,500	44,300
S97T000445	184:6RA	Drainable liquid	33,000	31,500	32,300

Table B2-8. Tank 241-S-106 Analytical Results: Antimony (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	<34.3	<34.3	<34.3
S97T000686		Lower half	<33.8	<33	<33.4
S97T000308	183:5	Lower half	<34.4	<34.7	<34.5
S97T000309	183:7	Lower half	<34.6	<35.1	<34.9
S97T000685		Lower half	<35.2	<33.6	<34.4
S97T000319	183:8	Upper half	<34.7	<33.9	<34.3
S97T000333		Lower half	<34.4	<35	<34.7
S97T000334	183:9	Upper half	<35	<34.3	<34.6
S97T000335		Lower half	<34.5	<35.1	<34.8
S97T000347	184:2	Lower half	<33.6	<33.3	<33.5
S97T000357	184:4	Upper half	<34.4	<33.2	<33.8
S97T000363		Lower half	<34.6	<34.8	<34.7
S97T001370	184:6	Upper half	<29.9	<29.8	<29.9
S97T000417		Lower half	<33.7	<35.5	<34.6
S97T000429	184:6R	Lower half	<31.4	<33	<32.2
S97T000442	184:6RA	Lower half	<33.3	<34	<33.6
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	<36.1	<36.1	<36.1
S97T000287	183:3	Drainable liquid	<36.1	<36.1	<36.1
S97T000288	183:4	Drainable liquid	<36.1	<36.1	<36.1
S97T000289	183:5	Drainable liquid	<36.1	<36.1	<36.1
S97T000290	183:7	Drainable liquid	<36.1	<36.1	<36.1
S97T000341	184:1	Drainable liquid	<36.1	<36.1	<36.1
S97T000351	184:2	Drainable liquid	<36.1	<36.1	<36.1
S97T000421	184:6	Drainable liquid	<36.1	<36.1	<36.1
S97T000445	184:6RA	Drainable liquid	<36.1	<36.1	<36.1

Table B2-9. Tank 241-S-106 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	<56	<55.5	<55.8
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	<52.3	<55	<53.6
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-10. Tank 241-S-106 Analytical Results: Barium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<28.6	<28.6	<28.6
S97T000686		Lower half	<28.2	<27.5	<27.9
S97T000308	183:5	Lower half	<28.7	<28.9	<28.8
S97T000309	183:7	Lower half	<28.8	<29.2	<29
S97T000685		Lower half	<29.3	<28	<28.6
S97T000319	183:8	Upper half	<28.9	<28.2	<28.5
S97T000333		Lower half	<28.7	<29.1	<28.9
S97T000334	183:9	Upper half	<29.2	<28.6	<28.9
S97T000335		Lower half	<28.8	<29.2	<29
S97T000347	184:2	Lower half	<28	<27.8	<27.9
S97T000357	184:4	Upper half	<28.7	<27.7	<28.2
S97T000363		Lower half	<28.9	<29	<28.9
S97T001370	184:6	Upper half	<24.9	<24.9	<24.9
S97T000417		Lower half	<28.1	<29.6	<28.9
S97T000429	184:6R	Lower half	<26.2	<27.5	<26.9
S97T000442	184:6RA	Lower half	<27.8	<28.3	<28.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000287	183:3	Drainable liquid	<30.1	<30.1	<30.1
S97T000288	183:4	Drainable liquid	<30.1	<30.1	<30.1
S97T000289	183:5	Drainable liquid	<30.1	<30.1	<30.1
S97T000290	183:7	Drainable liquid	<30.1	<30.1	<30.1
S97T000341	184:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000351	184:2	Drainable liquid	<30.1	<30.1	<30.1
S97T000421	184:6	Drainable liquid	<30.1	<30.1	<30.1
S97T000445	184:6RA	Drainable liquid	<30.1	<30.1	<30.1

Table B2-11. Tank 241-S-106 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<2.86	<2.86	<2.86
S97T000686		Lower half	<2.82	<2.75	<2.79
S97T000308	183:5	Lower half	<2.87	<2.89	<2.88
S97T000309	183:7	Lower half	<2.88	<2.92	<2.9
S97T000685		Lower half	<2.93	<2.8	<2.87
S97T000319	183:8	Upper half	<2.89	<2.82	<2.86
S97T000333		Lower half	<2.87	<2.91	<2.89
S97T000334	183:9	Upper half	<2.92	<2.86	<2.89
S97T000335		Lower half	<2.88	<2.92	<2.9
S97T000347	184:2	Lower half	<2.8	<2.78	<2.79
S97T000357	184:4	Upper half	<2.87	<2.77	<2.82
S97T000363		Lower half	<2.89	<2.9	<2.9
S97T001370	184:6	Upper half	<2.49	<2.49	<2.49
S97T000417		Lower half	<2.81	<2.96	<2.88
S97T000429	184:6R	Lower half	<2.62	<2.75	<2.69
S97T000442	184:6RA	Lower half	<2.78	<2.83	<2.8
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<3	<3	<3
S97T000287	183:3	Drainable liquid	<3	<3	<3
S97T000288	183:4	Drainable liquid	<3	<3	<3
S97T000289	183:5	Drainable liquid	<3	<3	<3
S97T000290	183:7	Drainable liquid	<3	<3	<3
S97T000341	184:1	Drainable liquid	<3	<3	<3
S97T000351	184:2	Drainable liquid	<3	<3	<3
S97T000421	184:6	Drainable liquid	<3	<3	<3
S97T000445	184:6RA	Drainable liquid	<3	<3	<3

Table B2-12. Tank 241-S-106 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	61.2	56.1	58.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	66.5	<56	<61.3
S97T000319	183:8	Upper half	163	165	164
S97T000333		Lower half	76.9	97.3	87.1[QC:e,j]
S97T000334	183:9	Upper half	86.6	82.3	84.4
S97T000335		Lower half	103	94	98.5
S97T000347	184:2	Lower half	595	355	475[QC:e]
S97T000357	184:4	Upper half	152	135	144
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	180	176	178
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	60.6	<55	<57.8
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-13. Tank 241-S-106 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	150	93.9	122[QC:e]
S97T000686		Lower half	148	137	143
S97T000308	183:5	Lower half	130	142	136
S97T000309	183:7	Lower half	128	129	129
S97T000685		Lower half	134	112	123
S97T000319	183:8	Upper half	123	125	124
S97T000333		Lower half	132	127	130
S97T000334	183:9	Upper half	121	127	124
S97T000335		Lower half	114	125	120
S97T000347	184:2	Lower half	85.2	107	96.1[QC:e]
S97T000357	184:4	Upper half	110	119	115
S97T000363		Lower half	99.9	124	112[QC:e]
S97T001370	184:6	Upper half	132	61	96.5[QC:e]
S97T000417		Lower half	86	106	96[QC:e]
S97T000429	184:6R	Lower half	88.3	102	95.2
S97T000442	184:6RA	Lower half	91.6	127	109[QC:e]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	90.6	88.8	89.7
S97T000287	183:3	Drainable liquid	96.8	107	102
S97T000288	183:4	Drainable liquid	108	113	111
S97T000289	183:5	Drainable liquid	131	125	128
S97T000290	183:7	Drainable liquid	115	114	115
S97T000341	184:1	Drainable liquid	91.5	97.3	94.4
S97T000351	184:2	Drainable liquid	95.8	85.2	90.5
S97T000421	184:6	Drainable liquid	131	128	130
S97T000445	184:6RA	Drainable liquid	116	107	112

Table B2-14. Tank 241-S-106 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<2.86	<2.86	<2.86
S97T000686		Lower half	2.84	<2.75	<2.8
S97T000308	183:5	Lower half	<2.87	<2.89	<2.88
S97T000309	183:7	Lower half	3.39	<2.92	<3.16
S97T000685		Lower half	<2.93	2.89	<2.91
S97T000319	183:8	Upper half	15.6	15.6	15.6
S97T000333		Lower half	8.78	9.12	8.95
S97T000334	183:9	Upper half	6.23	7.33	6.78
S97T000335		Lower half	10.5	10.6	10.6
S97T000347	184:2	Lower half	28.2	27.1	27.6
S97T000357	184:4	Upper half	13.5	13	13.3
S97T000363		Lower half	4.35	4.34	4.34
S97T001370	184:6	Upper half	17.9	16.1	17
S97T000417		Lower half	4.67	4.99	4.83
S97T000429	184:6R	Lower half	3.72	3.08	3.4
S97T000442	184:6RA	Lower half	5.12	4.61	4.87
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<3	<3	<3
S97T000287	183:3	Drainable liquid	<3	<3	<3
S97T000288	183:4	Drainable liquid	<3	<3	<3
S97T000289	183:5	Drainable liquid	<3	<3	<3
S97T000290	183:7	Drainable liquid	<3	<3	<3
S97T000341	184:1	Drainable liquid	<3	<3	<3
S97T000351	184:2	Drainable liquid	<3	<3	<3
S97T000421	184:6	Drainable liquid	<3	<3	<3
S97T000445	184:6RA	Drainable liquid	<3	<3	<3

Table B2-15. Tank 241-S-106 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T000307	183:4	Lower half	89.9	86.6	88.3
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	91.9	126	109[QC:e,j]
S97T000309	183:7	Lower half	119	114	117
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	172	182	177
S97T000333		Lower half	163	135	149
S97T000334	183:9	Upper half	155	105	130[QC:e,j]
S97T000335		Lower half	161	165	163
S97T000347	184:2	Lower half	312	293	303
S97T000357	184:4	Upper half	99.2	97.9	98.6
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	201	229	215
S97T000417		Lower half	67.6	59.8	63.7
S97T000429	184:6R	Lower half	<52.3	67.2	<59.8[QC:e,j]
S97T000442	184:6RA	Lower half	75.4	74.5	75
Liquids			μg/mL	μg/mL	μg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-16. Tank 241-S-106 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	<56	<55.5	<55.8
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	<52.3	<55	<53.6
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-17. Tank 241-S-106 Analytical Results: Chromium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T000307	183:4	Lower half	6,220	6,670	6,450
S97T000686		Lower half	6,200	6,810	6,510
S97T000308	183:5	Lower half	5,850	5,980	5,920
S97T000309	183:7	Lower half	4,390	4,430	4,410
S97T000685		Lower half	3,880	3,800	3,840
S97T000319	183:8	Upper half	8,700	8,690	8,700
S97T000333		Lower half	6,080	6,060	6,070
S97T000334	183:9	Upper half	4,940	5,040	4,990
S97T000335		Lower half	5,720	5,950	5840[QC:d,i]
S97T000347	184:2	Lower half	5,800	5,490	5,650
S97T000357	184:4	Upper half	7,450	7,430	7,440
S97T000363		Lower half	4,140	4,490	4,320
S97T001370	184:6	Upper half	5,760	5,630	5,700
S97T000417		Lower half	4,020	3,610	3,820[QC:d,i]
S97T000429	184:6R	Lower half	3,110	3,110	3,110[QC:c,i]
S97T000442	184:6RA	Lower half	3,120	3,500	3,310
Liquids			μg/mL	μg/mL	μg/mL
S97T000277	183:1	Drainable liquid	9,650	9,490	9,570[QC:c,i]
S97T000287	183:3	Drainable liquid	9,910	10,700	10,300
S97T000288	183:4	Drainable liquid	10,200	10,100	10,200
S97T000289	183:5	Drainable liquid	10,700	10,000	10,400
S97T000290	183:7	Drainable liquid	7,940	7,880	7,910[QC:c,i]
S97T000341	184:1	Drainable liquid	10,100	10,700	10,400[QC:c,i]
S97T000351	184:2	Drainable liquid	10,200	9,490	9,850
S97T000421	184:6	Drainable liquid	9,440	9,190	9,320
S97T000445	184:6RA	Drainable liquid	7,500	7,200	7,350

Table B2-18. Tank 241-S-106 Analytical Results: Cobalt (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<11.4	<11.4	<11.4
S97T000686		Lower half	<11.3	<11	<11.2
S97T000308	183:5	Lower half	<11.5	<11.6	<11.6
S97T000309	183:7	Lower half	<11.5	<11.7	<11.6
S97T000685		Lower half	<11.7	<11.2	<11.4
S97T000319	183:8	Upper half	<11.6	<11.3	<11.4
S97T000333		Lower half	<11.5	<11.7	<11.6
S97T000334	183:9	Upper half	<11.7	<11.4	<11.6
S97T000335		Lower half	<11.5	<11.7	<11.6
S97T000347	184:2	Lower half	<11.2	<11.1	<11.1
S97T000357	184:4	Upper half	<11.5	<11.1	<11.3
S97T000363		Lower half	<11.5	<11.6	<11.6
S97T001370	184:6	Upper half	<9.96	<9.95	<9.96
S97T000417		Lower half	<11.2	<11.8	<11.5
S97T000429	184:6R	Lower half	<10.5	<11	<10.8
S97T000442	184:6RA	Lower half	<11.1	<11.3	<11.2
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<12	<12	<12
S97T000287	183:3	Drainable liquid	<12	<12	<12
S97T000288	183:4	Drainable liquid	<12	<12	<12
S97T000289	183:5	Drainable liquid	<12	<12	<12
S97T000290	183:7	Drainable liquid	<12	<12	<12
S97T000341	184:1	Drainable liquid	<12	<12	<12
S97T000351	184:2	Drainable liquid	<12	<12	<12
S97T000421	184:6	Drainable liquid	<12	<12	<12
S97T000445	184:6RA	Drainable liquid	<12	<12	<12

Table B2-19. Tank 241-S-106 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<5.72	<5.71	<5.71
S97T000686		Lower half	<5.64	<5.5	<5.57
S97T000308	183:5	Lower half	<5.74	<5.79	<5.77
S97T000309	183:7	Lower half	<5.77	<5.84	<5.8
S97T000685		Lower half	<5.87	<5.6	<5.73
S97T000319	183:8	Upper half	<5.79	<5.64	<5.71
S97T000333		Lower half	<5.74	<5.83	<5.79
S97T000334	183:9	Upper half	<5.84	<5.72	<5.78
S97T000335		Lower half	<5.75	<5.84	<5.8
S97T000347	184:2	Lower half	<5.6	<5.55	<5.57[QC:a]
S97T000357	184:4	Upper half	<5.73	<5.53	<5.63[QC:a]
S97T000363		Lower half	<5.77	<5.81	<5.79[QC:a]
S97T001370	184:6	Upper half	<4.98	<4.97	<4.97
S97T000417		Lower half	<5.62	<5.92	<5.77[QC:a]
S97T000429	184:6R	Lower half	<5.23	<5.5	<5.37[QC:a]
S97T000442	184:6RA	Lower half	<5.55	<5.67	<5.61[QC:a]
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000287	183:3	Drainable liquid	<6.01	<6.01	<6.01
S97T000288	183:4	Drainable liquid	<6.01	<6.01	<6.01
S97T000289	183:5	Drainable liquid	<6.01	<6.01	<6.01
S97T000290	183:7	Drainable liquid	<6.01	<6.01	<6.01
S97T000341	184:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000351	184:2	Drainable liquid	<6.01	<6.01	<6.01
S97T000421	184:6	Drainable liquid	<6.01	<6.01	<6.01
S97T000445	184:6RA	Drainable liquid	<6.01	<6.01	<6.01

Table B2-20. Tank 241-S-106 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**μg/g**	**μg/g**	**μg/g**
S97T000307	183:4	Lower half	192	130	161[QC:e,j]
S97T000686		Lower half	1,160	214	687[QC:e]
S97T000308	183:5	Lower half	138	106	122[QC:e,j]
S97T000309	183:7	Lower half	1,280	1,670	1,480[QC:c,e,i]
S97T000685		Lower half	802	4,460	2,630[QC:d,e,i]
S97T000319	183:8	Upper half	247	668	458[QC:e]
S97T000333		Lower half	108	117	113
S97T000334	183:9	Upper half	237	542	390[QC:e]
S97T000335		Lower half	144	172	158
S97T000347	184:2	Lower half	20,500	2,520	11,500[QC:a,e]
S97T000357	184:4	Upper half	254	147	201[QC:a,e,j]
S97T000363		Lower half	39.7	41.8	40.8[QC:a]
S97T001370	184:6	Upper half	901	651	776[QC:e]
S97T000417		Lower half	146	137	142[QC:a]
S97T000429	184:6R	Lower half	2,220	363	1,290[QC:a,c,e]
S97T000442	184:6RA	Lower half	1,140	1,650	1,400[QC:a,e]
Liquids			**μg/mL**	**μg/mL**	**μg/mL**
S97T000277	183:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000287	183:3	Drainable liquid	<30.1	<30.1	<30.1
S97T000288	183:4	Drainable liquid	<30.1	<30.1	<30.1
S97T000289	183:5	Drainable liquid	<30.1	<30.1	<30.1
S97T000290	183:7	Drainable liquid	<30.1	<30.1	<30.1
S97T000341	184:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000351	184:2	Drainable liquid	<30.1	<30.1	<30.1
S97T000421	184:6	Drainable liquid	<30.1	<30.1	<30.1
S97T000445	184:6RA	Drainable liquid	<30.1	<30.1	<30.1

Table B2-21. Tank 241-S-106 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<28.6	<28.6	<28.6
S97T000686		Lower half	<28.2	<27.5	<27.9
S97T000308	183:5	Lower half	<28.7	<28.9	<28.8
S97T000309	183:7	Lower half	<28.8	<29.2	<29
S97T000685		Lower half	<29.3	<28	<28.6
S97T000319	183:8	Upper half	<28.9	<28.2	<28.5
S97T000333		Lower half	<28.7	<29.1	<28.9
S97T000334	183:9	Upper half	<29.2	<28.6	<28.9
S97T000335		Lower half	<28.8	<29.2	<29
S97T000347	184:2	Lower half	<28	<27.8	<27.9
S97T000357	184:4	Upper half	<28.7	<27.7	<28.2
S97T000363		Lower half	<28.9	<29	<28.9
S97T001370	184:6	Upper half	<24.9	<24.9	<24.9
S97T000417		Lower half	<28.1	<29.6	<28.9
S97T000429	184:6R	Lower half	<26.2	<27.5	<26.9
S97T000442	184:6RA	Lower half	<27.8	<28.3	<28.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000287	183:3	Drainable liquid	<30.1	<30.1	<30.1
S97T000288	183:4	Drainable liquid	<30.1	<30.1	<30.1
S97T000289	183:5	Drainable liquid	<30.1	<30.1	<30.1
S97T000290	183:7	Drainable liquid	<30.1	<30.1	<30.1
S97T000341	184:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000351	184:2	Drainable liquid	<30.1	<30.1	<30.1
S97T000421	184:6	Drainable liquid	<30.1	<30.1	<30.1
S97T000445	184:6RA	Drainable liquid	<30.1	<30.1	<30.1

Table B2-22. Tank 241-S-106 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**μg/g**	**μg/g**	**μg/g**
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	285	93.1	189[QC:e,j]
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	<52.3	<55	<53.6
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			**μg/mL**	**μg/mL**	**μg/mL**
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-23. Tank 241-S-106 Analytical Results: Lithium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	72.7	78.6	75.7
S97T000686		Lower half	67.4	78	72.7
S97T000308	183:5	Lower half	18.7	19.6	19.1
S97T000309	183:7	Lower half	70.2	68	69.1
S97T000685		Lower half	48.3	63.6	56[QC:e]
S97T000319	183:8	Upper half	42.4	43.7	43
S97T000333		Lower half	<5.74	<5.83	<5.79
S97T000334	183:9	Upper half	47.7	51.5	49.6
S97T000335		Lower half	6.97	6.73	6.85
S97T000347	184:2	Lower half	<5.6	<5.55	<5.57
S97T000357	184:4	Upper half	13.7	15.1	14.4
S97T000363		Lower half	12.1	13.3	12.7
S97T001370	184:6	Upper half	104	102	103
S97T000417		Lower half	97.9	103	100
S97T000429	184:6R	Lower half	106	118	112
S97T000442	184:6RA	Lower half	300	322	311
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000287	183:3	Drainable liquid	<6.01	<6.01	<6.01
S97T000288	183:4	Drainable liquid	8.61	8.25	8.43
S97T000289	183:5	Drainable liquid	<6.01	<6.01	<6.01
S97T000290	183:7	Drainable liquid	<6.01	<6.01	<6.01
S97T000341	184:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000351	184:2	Drainable liquid	14.1	13.2	13.6
S97T000421	184:6	Drainable liquid	25	25.1	25.1
S97T000445	184:6RA	Drainable liquid	<6.01	<6.01	<6.01

Table B2-24. Tank 241-S-106 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	<56	<55.5	<55.8
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	<52.3	<55	<53.6
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-25. Tank 241-S-106 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	9.28	7.5	8.39[QC:e,j]
S97T000686		Lower half	11.8	8.46	10.1[QC:e,j]
S97T000308	183:5	Lower half	11.8	11.3	11.6
S97T000309	183:7	Lower half	25.4	30.1	27.8
S97T000685		Lower half	18.8	67.3	43[QC:e]
S97T000319	183:8	Upper half	78.9	82.6	80.8
S97T000333		Lower half	49.5	50	49.8
S97T000334	183:9	Upper half	27.7	31.1	29.4
S97T000335		Lower half	42.2	45.5	43.9
S97T000347	184:2	Lower half	242	169	206[QC:e]
S97T000357	184:4	Upper half	115	115	115
S97T000363		Lower half	25.4	25.9	25.6
S97T001370	184:6	Upper half	197	188	193
S97T000417		Lower half	45.4	39.2	42.3
S97T000429	184:6R	Lower half	28.2	17.5	22.9[QC:e,j]
S97T000442	184:6RA	Lower half	36.9	34.8	35.8
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000287	183:3	Drainable liquid	<6.01	<6.01	<6.01
S97T000288	183:4	Drainable liquid	<6.01	<6.01	<6.01
S97T000289	183:5	Drainable liquid	<6.01	<6.01	<6.01
S97T000290	183:7	Drainable liquid	<6.01	<6.01	<6.01
S97T000341	184:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000351	184:2	Drainable liquid	<6.01	<6.01	<6.01
S97T000421	184:6	Drainable liquid	<6.01	<6.01	<6.01
S97T000445	184:6RA	Drainable liquid	<6.01	<6.01	<6.01

Table B2-26. Tank 241-S-106 Analytical Results: Molybdenum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<28.6	32	<30.3
S97T000686		Lower half	30.4	33.5	31.9
S97T000308	183:5	Lower half	32.5	33.5	33
S97T000309	183:7	Lower half	<28.8	<29.2	<29
S97T000685		Lower half	<29.3	<28	<28.6
S97T000319	183:8	Upper half	34.5	33.1	33.8
S97T000333		Lower half	<28.7	<29.1	<28.9
S97T000334	183:9	Upper half	<29.2	<28.6	<28.9
S97T000335		Lower half	<28.8	<29.2	<29
S97T000347	184:2	Lower half	<28	<27.8	<27.9
S97T000357	184:4	Upper half	<28.7	<27.7	<28.2
S97T000363		Lower half	<28.9	<29	<28.9
S97T001370	184:6	Upper half	<24.9	<24.9	<24.9
S97T000417		Lower half	<28.1	<29.6	<28.9
S97T000429	184:6R	Lower half	<26.2	<27.5	<26.9
S97T000442	184:6RA	Lower half	<27.8	<28.3	<28.1
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	60.5	58.1	59.3
S97T000287	183:3	Drainable liquid	64.2	69.3	66.8
S97T000288	183:4	Drainable liquid	74.5	72.6	73.5
S97T000289	183:5	Drainable liquid	88.4	83.7	86.1
S97T000290	183:7	Drainable liquid	77.8	77	77.4
S97T000341	184:1	Drainable liquid	62.5	66	64.3
S97T000351	184:2	Drainable liquid	64.4	59.4	61.9
S97T000421	184:6	Drainable liquid	88.4	83.2	85.8
S97T000445	184:6RA	Drainable liquid	74.4	69.7	72.1

Table B2-27. Tank 241-S-106 Analytical Results: Neodymium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	<56	<55.5	<55.8
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	<52.3	<55	<53.6
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			μg/mL	μg/mL	μg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-28. Tank 241-S-106 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**μg/g**	**μg/g**	**μg/g**
S97T000307	183:4	Lower half	12.6	<11.4	<12
S97T000686		Lower half	<11.3	14.1	<12.7[QC:e,j]
S97T000308	183:5	Lower half	<11.5	<11.6	<11.6
S97T000309	183:7	Lower half	12.6	12.9	12.8
S97T000685		Lower half	12.8	12.6	12.7
S97T000319	183:8	Upper half	53.6	53.4	53.5
S97T000333		Lower half	31	26.6	28.8
S97T000334	183:9	Upper half	23	25.8	24.4
S97T000335		Lower half	34.6	32.5	33.5
S97T000347	184:2	Lower half	78.9	82.3	80.6
S97T000357	184:4	Upper half	47.2	49.9	48.5
S97T000363		Lower half	12	13.5	12.8
S97T001370	184:6	Upper half	57	50.8	53.9
S97T000417		Lower half	25.3	21.6	23.5
S97T000429	184:6R	Lower half	11.9	<11	<11.4
S97T000442	184:6RA	Lower half	21.7	27.4	24.5[QC:e,j]
Liquids			**μg/mL**	**μg/mL**	**μg/mL**
S97T000277	183:1	Drainable liquid	<12	<12	<12
S97T000287	183:3	Drainable liquid	<12	<12	<12
S97T000288	183:4	Drainable liquid	<12	<12	<12
S97T000289	183:5	Drainable liquid	<12	<12	<12
S97T000290	183:7	Drainable liquid	<12	<12	<12
S97T000341	184:1	Drainable liquid	<12	<12	<12
S97T000351	184:2	Drainable liquid	<12	<12	<12
S97T000421	184:6	Drainable liquid	<12	<12	<12
S97T000445	184:6RA	Drainable liquid	<12	<12	<12

Table B2-29. Tank 241-S-106 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T000307	183:4	Lower half	1,560	2,450	2,010[QC:e]
S97T000686		Lower half	2,430	2,220	2,330
S97T000308	183:5	Lower half	2,760	2,500	2,630
S97T000309	183:7	Lower half	3,510	4,660	4,090[QC:c,e,i]
S97T000685		Lower half	3,780	7,110	5,450[QC:d,e,i]
S97T000319	183:8	Upper half	2,420	2,840	2,630
S97T000333		Lower half	3,280	4,110	3,700[QC:e]
S97T000334	183:9	Upper half	5,440	2,890	4,170[QC:e]
S97T000335		Lower half	15,000	13,800	14,400[QC:c,i]
S97T000347	184:2	Lower half	1,730	2,680	2,210[QC:e]
S97T000357	184:4	Upper half	10,400	9,010	9,710
S97T000363		Lower half	1,980	1,620	1,800
S97T001370	184:6	Upper half	21,800	20,700	21,300
S97T000417		Lower half	13,000	12,800	12,900[QC:d]
S97T000429	184:6R	Lower half	8,730	8,070	8,400[QC:c]
S97T000442	184:6RA	Lower half	8,260	10,200	9,230[QC:e]
Liquids			μg/mL	μg/mL	μg/mL
S97T000277	183:1	Drainable liquid	796	778	787
S97T000287	183:3	Drainable liquid	688	750	719
S97T000288	183:4	Drainable liquid	614	613	614
S97T000289	183:5	Drainable liquid	601	562	582
S97T000290	183:7	Drainable liquid	561	568	565
S97T000341	184:1	Drainable liquid	794	846	820
S97T000351	184:2	Drainable liquid	657	609	633
S97T000421	184:6	Drainable liquid	586	568	577
S97T000445	184:6RA	Drainable liquid	629	608	619

Table B2-30. Tank 241-S-106 Analytical Results: Potassium (ICP)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	915	1,040	978
S97T000686		Lower half	957	1,070	1,010
S97T000308	183:5	Lower half	878	983	931
S97T000309	183:7	Lower half	680	669	675
S97T000685		Lower half	715	701	708
S97T000319	183:8	Upper half	809	930	870
S97T000333		Lower half	664	617	641
S97T000334	183:9	Upper half	429	638	534[QC:e,j]
S97T000335		Lower half	489	576	533
S97T000347	184:2	Lower half	489	584	537
S97T000357	184:4	Upper half	606	627	617
S97T000363		Lower half	709	622	666
S97T001370	184:6	Upper half	419	398	409
S97T000417		Lower half	551	521	536
S97T000429	184:6R	Lower half	487	582	535
S97T000442	184:6RA	Lower half	435	546	491[QC:e,j]
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	1,540	1,510	1,530
S97T000287	183:3	Drainable liquid	1,840	1,840	1,840
S97T000288	183:4	Drainable liquid	1,800	2,010	1,910
S97T000289	183:5	Drainable liquid	2,210	2,180	2,200
S97T000290	183:7	Drainable liquid	1,850	1,770	1,810
S97T000341	184:1	Drainable liquid	1,690	1,770	1,730
S97T000351	184:2	Drainable liquid	1,700	1,610	1,660
S97T000421	184:6	Drainable liquid	2,080	2,020	2,050
S97T000445	184:6RA	Drainable liquid	1,750	1,640	1,700

Table B2-31. Tank 241-S-106 Analytical Results: Samarium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	<56	<55.5	<55.8
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3
S97T000363		Lower half	<57.7	<58.1	<57.9
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7
S97T000429	184:6R	Lower half	<52.3	<55	<53.6
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-32. Tank 241-S-106 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<57.2	<57.1	<57.2
S97T000686		Lower half	<56.4	<55	<55.7
S97T000308	183:5	Lower half	<57.4	<57.9	<57.6
S97T000309	183:7	Lower half	<57.7	<58.4	<58
S97T000685		Lower half	<58.7	<56	<57.4
S97T000319	183:8	Upper half	<57.9	<56.4	<57.1
S97T000333		Lower half	<57.4	<58.3	<57.8
S97T000334	183:9	Upper half	<58.4	<57.2	<57.8
S97T000335		Lower half	<57.5	<58.4	<58
S97T000347	184:2	Lower half	<56	<55.5	<55.8[QC:a]
S97T000357	184:4	Upper half	<57.3	<55.3	<56.3[QC:a]
S97T000363		Lower half	<57.7	<58.1	<57.9[QC:a]
S97T001370	184:6	Upper half	<49.8	<49.7	<49.8
S97T000417		Lower half	<56.2	<59.2	<57.7[QC:a]
S97T000429	184:6R	Lower half	<52.3	<55	<53.6[QC:a]
S97T000442	184:6RA	Lower half	<55.5	<56.7	<56.1[QC:a]
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000287	183:3	Drainable liquid	<60.1	<60.1	<60.1
S97T000288	183:4	Drainable liquid	<60.1	<60.1	<60.1
S97T000289	183:5	Drainable liquid	<60.1	<60.1	<60.1
S97T000290	183:7	Drainable liquid	<60.1	<60.1	<60.1
S97T000341	184:1	Drainable liquid	<60.1	<60.1	<60.1
S97T000351	184:2	Drainable liquid	<60.1	<60.1	<60.1
S97T000421	184:6	Drainable liquid	<60.1	<60.1	<60.1
S97T000445	184:6RA	Drainable liquid	<60.1	<60.1	<60.1

Table B2-33. Tank 241-S-106 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	504	294	399[QC:b,e]
S97T000686		Lower half	459	440	450[QC:b]
S97T000308	183:5	Lower half	492	554	523[QC:b]
S97T000309	183:7	Lower half	463	478	471[QC:b]
S97T000685		Lower half	253	348	301[QC:b,d,e]
S97T000319	183:8	Upper half	494	490	492[QC:b]
S97T000333		Lower half	548	536	542[QC:b]
S97T000334	183:9	Upper half	455	548	502[QC:b]
S97T000335		Lower half	579	646	613[QC:b]
S97T000347	184:2	Lower half	603	704	654[QC:b]
S97T000357	184:4	Upper half	400	448	424[QC:b]
S97T000363		Lower half	419	576	498[QC:b,e]
S97T001370	184:6	Upper half	149	389	269[QC:b,e]
S97T000417		Lower half	360	470	415[QC:b,e]
S97T000429	184:6R	Lower half	287	380	334[QC:b,e]
S97T000442	184:6RA	Lower half	316	524	420[QC:b,e]
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	154	149	152
S97T000287	183:3	Drainable liquid	139	139	139
S97T000288	183:4	Drainable liquid	130	125	128
S97T000289	183:5	Drainable liquid	196	148	172[QC:e,j]
S97T000290	183:7	Drainable liquid	172	153	163
S97T000341	184:1	Drainable liquid	110	110	110
S97T000351	184:2	Drainable liquid	96.9	96.4	96.7
S97T000421	184:6	Drainable liquid	231	236	234
S97T000445	184:6RA	Drainable liquid	470	440	455

Table B2-34. Tank 241-S-106 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	13.4	13.3	13.4
S97T000686		Lower half	16.4	16.2	16.3
S97T000308	183:5	Lower half	13.8	14	13.9
S97T000309	183:7	Lower half	14	13.2	13.6
S97T000685		Lower half	16.8	15.8	16.3
S97T000319	183:8	Upper half	14.4	13.8	14.1
S97T000333		Lower half	14.3	14.1	14.2
S97T000334	183:9	Upper half	14.2	13.9	14.1
S97T000335		Lower half	12.2	11.9	12.1
S97T000347	184:2	Lower half	11.9	16	13.9[QC:e,j]
S97T000357	184:4	Upper half	16.5	16.2	16.4
S97T000363		Lower half	16.3	16.1	16.2
S97T001370	184:6	Upper half	14.6	14.4	14.5
S97T000417		Lower half	16	15.9	15.9
S97T000429	184:6R	Lower half	16	15.4	15.7
S97T000442	184:6RA	Lower half	39.8	31.1	35.5[QC:e,j]
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	18.1	17.9	18
S97T000287	183:3	Drainable liquid	18.2	19.2	18.7
S97T000288	183:4	Drainable liquid	17.9	17	17.4
S97T000289	183:5	Drainable liquid	19.3	18.6	19
S97T000290	183:7	Drainable liquid	17	16.3	16.6
S97T000341	184:1	Drainable liquid	18.3	19.9	19.1
S97T000351	184:2	Drainable liquid	19.9	17.7	18.8
S97T000421	184:6	Drainable liquid	18.9	18.2	18.5
S97T000445	184:6RA	Drainable liquid	17.3	16.4	16.9

Table B2-35. Tank 241-S-106 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	1.89E+05	1.89E+05	1.89E+05
S97T000686		Lower half	2.09E+05	2.03E+05	2.06E+05
S97T000308	183:5	Lower half	1.95E+05	1.93E+05	1.94E+05
S97T000309	183:7	Lower half	1.96E+05	1.94E+05	1.95E+05[QC:d,i]
S97T000685		Lower half	2.23E+05	2.20E+05	2.22E+05[QC:c,i]
S97T000319	183:8	Upper half	1.88E+05	1.87E+05	1.88E+05
S97T000333		Lower half	1.96E+05	1.95E+05	1.96E+05
S97T000334	183:9	Upper half	1.91E+05	1.87E+05	1.89E+05
S97T000335		Lower half	1.70E+05	1.63E+05	1.67E+05[QC:d,i]
S97T000347	184:2	Lower half	2.00E+05	2.16E+05	2.08E+05
S97T000357	184:4	Upper half	2.24E+05	2.25E+05	2.25E+05
S97T000363		Lower half	2.21E+05	2.20E+05	2.21E+05
S97T001370	184:6	Upper half	2.06E+05	2.06E+05	2.06E+05
S97T000417		Lower half	2.15E+05	2.20E+05	2.18E+05[QC:d,i]
S97T000429	184:6R	Lower half	2.21E+05	2.14E+05	2.18E+05[QC:c,i]
S97T000442	184:6RA	Lower half	2.20E+05	2.25E+05	2.23E+05
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	2.42E+05	2.40E+05	2.41E+05[QC:c,i]
S97T000287	183:3	Drainable liquid	2.33E+05	2.55E+05	2.44E+05
S97T000288	183:4	Drainable liquid	2.42E+05	2.38E+05	2.40E+05
S97T000289	183:5	Drainable liquid	2.62E+05	2.46E+05	2.54E+05
S97T000290	183:7	Drainable liquid	2.33E+05	2.31E+05	2.32E+05[QC:c,i]
S97T000341	184:1	Drainable liquid	2.49E+05	2.68E+05	2.59E+05[QC:c,i]
S97T000351	184:2	Drainable liquid	2.52E+05	2.32E+05	2.42E+05
S97T000421	184:6	Drainable liquid	2.55E+05	2.45E+05	2.50E+05
S97T000445	184:6RA	Drainable liquid	2.42E+05	2.30E+05	2.36E+05

Table B2-36. Tank 241-S-106 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T000307	183:4	Lower half	<5.72	<5.71	<5.71
S97T000686		Lower half	<5.64	<5.5	<5.57
S97T000308	183:5	Lower half	<5.74	<5.79	<5.77
S97T000309	183:7	Lower half	<5.77	<5.84	<5.8
S97T000685		Lower half	<5.87	<5.6	<5.73
S97T000319	183:8	Upper half	<5.79	<5.64	<5.71
S97T000333		Lower half	<5.74	<5.83	<5.79
S97T000334	183:9	Upper half	<5.84	<5.72	<5.78
S97T000335		Lower half	<5.75	<5.84	<5.8
S97T000347	184:2	Lower half	<5.6	<5.55	<5.57
S97T000357	184:4	Upper half	<5.73	<5.53	<5.63
S97T000363		Lower half	<5.77	<5.81	<5.79
S97T001370	184:6	Upper half	5.72	5.37	5.54
S97T000417		Lower half	<5.62	<5.92	<5.77
S97T000429	184:6R	Lower half	<5.23	<5.5	<5.37
S97T000442	184:6RA	Lower half	<5.55	<5.67	<5.61
Liquids			μg/mL	μg/mL	μg/mL
S97T000277	183:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000287	183:3	Drainable liquid	<6.01	<6.01	<6.01
S97T000288	183:4	Drainable liquid	<6.01	<6.01	<6.01
S97T000289	183:5	Drainable liquid	<6.01	<6.01	<6.01
S97T000290	183:7	Drainable liquid	<6.01	<6.01	<6.01
S97T000341	184:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000351	184:2	Drainable liquid	<6.01	<6.01	<6.01
S97T000421	184:6	Drainable liquid	<6.01	<6.01	<6.01
S97T000445	184:6RA	Drainable liquid	<6.01	<6.01	<6.01

Table B2-37. Tank 241-S-106 Analytical Results: Sulfur (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T000307	183:4	Lower half	2,090	2,420	2,260
S97T000686		Lower half	2,910	2,500	2,710
S97T000308	183:5	Lower half	2,360	2,480	2,420
S97T000309	183:7	Lower half	657	621	639
S97T000685		Lower half	600	682	641
S97T000319	183:8	Upper half	2,250	2,240	2,250
S97T000333		Lower half	2,480	2,240	2,360
S97T000334	183:9	Upper half	1,650	1,680	1,670
S97T000335		Lower half	3,150	2,240	2,700[QC:c,e]
S97T000347	184:2	Lower half	397	411	404
S97T000357	184:4	Upper half	7,510	7,700	7,610
S97T000363		Lower half	1,980	2,190	2,090
S97T001370	184:6	Upper half	5,380	4,470	4,930
S97T000417		Lower half	1,570	1,060	1,320[QC:c,e]
S97T000429	184:6R	Lower half	1,640	972	1,310[QC:c,e]
S97T000442	184:6RA	Lower half	2,600	4,290	3,450[QC:e]
Liquids			μg/mL	μg/mL	μg/mL
S97T000277	183:1	Drainable liquid	1,790	1,740	1,770
S97T000287	183:3	Drainable liquid	1,170	1,290	1,230
S97T000288	183:4	Drainable liquid	853	842	848
S97T000289	183:5	Drainable liquid	671	629	650
S97T000290	183:7	Drainable liquid	661	666	664
S97T000341	184:1	Drainable liquid	1,790	1,910	1,850
S97T000351	184:2	Drainable liquid	1,760	1,640	1,700
S97T000421	184:6	Drainable liquid	949	909	929
S97T000445	184:6RA	Drainable liquid	1,280	1,220	1,250

Table B2-38. Tank 241-S-106 Analytical Results: Thallium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<114	<114	<114
S97T000686		Lower half	<113	<110	<112
S97T000308	183:5	Lower half	<115	<116	<116
S97T000309	183:7	Lower half	<115	<117	<116
S97T000685		Lower half	<117	<112	<115
S97T000319	183:8	Upper half	<116	<113	<115
S97T000333		Lower half	<115	<117	<116
S97T000334	183:9	Upper half	<117	<114	<116
S97T000335		Lower half	<115	<117	<116
S97T000347	184:2	Lower half	<112	<111	<112[QC:a]
S97T000357	184:4	Upper half	<115	<111	<113[QC:a]
S97T000363		Lower half	<115	<116	<116[QC:a]
S97T001370	184:6	Upper half	<99.6	<99.5	<99.5
S97T000417		Lower half	<112	<118	<115[QC:a]
S97T000429	184:6R	Lower half	<105	<110	<108[QC:a]
S97T000442	184:6RA	Lower half	<111	<113	<112[QC:a]
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<120	<120	<120
S97T000287	183:3	Drainable liquid	<120	<120	<120
S97T000288	183:4	Drainable liquid	<120	<120	<120
S97T000289	183:5	Drainable liquid	<120	<120	<120
S97T000290	183:7	Drainable liquid	<120	<120	<120
S97T000341	184:1	Drainable liquid	<120	<120	<120
S97T000351	184:2	Drainable liquid	<120	<120	<120
S97T000421	184:6	Drainable liquid	<120	<120	<120
S97T000445	184:6RA	Drainable liquid	<120	<120	<120

Table B2-39. Tank 241-S-106 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	<5.72	<5.71	<5.71
S97T000686		Lower half	<5.64	<5.5	<5.57
S97T000308	183:5	Lower half	<5.74	<5.79	<5.77
S97T000309	183:7	Lower half	<5.77	<5.84	<5.8
S97T000685		Lower half	<5.87	<5.6	<5.73
S97T000319	183:8	Upper half	<5.79	<5.64	<5.71
S97T000333		Lower half	<5.74	<5.83	<5.79
S97T000334	183:9	Upper half	<5.84	<5.72	<5.78
S97T000335		Lower half	<5.75	<5.84	<5.8
S97T000347	184:2	Lower half	<5.6	<5.55	<5.57[QC:a]
S97T000357	184:4	Upper half	<5.73	<5.53	<5.63[QC:a]
S97T000363		Lower half	<5.77	<5.81	<5.79[QC:a]
S97T001370	184:6	Upper half	<4.98	<4.97	<4.97
S97T000417		Lower half	<5.62	<5.92	<5.77[QC:a]
S97T000429	184:6R	Lower half	<5.23	<5.5	<5.37[QC:a]
S97T000442	184:6RA	Lower half	<5.55	<5.67	<5.61[QC:a]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000287	183:3	Drainable liquid	<6.01	<6.01	<6.01
S97T000288	183:4	Drainable liquid	<6.01	<6.01	<6.01
S97T000289	183:5	Drainable liquid	<6.01	<6.01	<6.01
S97T000290	183:7	Drainable liquid	<6.01	<6.01	<6.01
S97T000341	184:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000351	184:2	Drainable liquid	<6.01	<6.01	<6.01
S97T000421	184:6	Drainable liquid	<6.01	<6.01	<6.01
S97T000445	184:6RA	Drainable liquid	<6.01	<6.01	<6.01

Table B2-40. Tank 241-S-106 Analytical Results: Total Uranium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	<286	<286	<286
S97T000686		Lower half	<282	<275	<279
S97T000308	183:5	Lower half	<287	<289	<288
S97T000309	183:7	Lower half	<288	<292	<290
S97T000685		Lower half	<293	<280	<287
S97T000319	183:8	Upper half	<289	295	<292
S97T000333		Lower half	<287	<291	<289
S97T000334	183:9	Upper half	<292	<286	<289
S97T000335		Lower half	<288	<292	<290
S97T000347	184:2	Lower half	730	701	716
S97T000357	184:4	Upper half	371	370	371
S97T000363		Lower half	<289	<290	<290
S97T001370	184:6	Upper half	329	327	328
S97T000417		Lower half	<281	<296	<289
S97T000429	184:6R	Lower half	<262	<275	<269
S97T000442	184:6RA	Lower half	<278	<283	<281
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	<300	<300	<300
S97T000287	183:3	Drainable liquid	<300	<300	<300
S97T000288	183:4	Drainable liquid	<300	<300	<300
S97T000289	183:5	Drainable liquid	<300	<300	<300
S97T000290	183:7	Drainable liquid	<300	<300	<300
S97T000341	184:1	Drainable liquid	<300	<300	<300
S97T000351	184:2	Drainable liquid	<300	<300	<300
S97T000421	184:6	Drainable liquid	<300	<300	<300
S97T000445	184:6RA	Drainable liquid	<300	<300	<300

Table B2-41. Tank 241-S-106 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	<28.6	<28.6	<28.6
S97T000686		Lower half	<28.2	<27.5	<27.9
S97T000308	183:5	Lower half	<28.7	<28.9	<28.8
S97T000309	183:7	Lower half	<28.8	<29.2	<29
S97T000685		Lower half	<29.3	<28	<28.6
S97T000319	183:8	Upper half	<28.9	<28.2	<28.5
S97T000333		Lower half	<28.7	<29.1	<28.9
S97T000334	183:9	Upper half	<29.2	<28.6	<28.9
S97T000335		Lower half	<28.8	<29.2	<29
S97T000347	184:2	Lower half	<28	<27.8	<27.9
S97T000357	184:4	Upper half	<28.7	<27.7	<28.2
S97T000363		Lower half	<28.9	<29	<28.9
S97T001370	184:6	Upper half	31.3	29.1	30.2
S97T000417		Lower half	<28.1	<29.6	<28.9
S97T000429	184:6R	Lower half	<26.2	<27.5	<26.9
S97T000442	184:6RA	Lower half	<27.8	<28.3	<28.1
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000287	183:3	Drainable liquid	<30.1	<30.1	<30.1
S97T000288	183:4	Drainable liquid	<30.1	<30.1	<30.1
S97T000289	183:5	Drainable liquid	<30.1	<30.1	<30.1
S97T000290	183:7	Drainable liquid	<30.1	<30.1	<30.1
S97T000341	184:1	Drainable liquid	<30.1	<30.1	<30.1
S97T000351	184:2	Drainable liquid	<30.1	<30.1	<30.1
S97T000421	184:6	Drainable liquid	<30.1	<30.1	<30.1
S97T000445	184:6RA	Drainable liquid	<30.1	<30.1	<30.1

Table B2-42. Tank 241-S-106 Analytical Results: Zinc (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T000307	183:4	Lower half	9.67	11.3	10.5
S97T000686		Lower half	9.46	9.65	9.55
S97T000308	183:5	Lower half	13.1	12.3	12.7
S97T000309	183:7	Lower half	17.9	15.1	16.5
S97T000685		Lower half	11.9	16.7	14.3[QC:e,j]
S97T000319	183:8	Upper half	26.6	27.9	27.3
S97T000333		Lower half	16.3	21.6	19[QC:e,j]
S97T000334	183:9	Upper half	23.2	22.6	22.9
S97T000335		Lower half	18.6	19.8	19.2
S97T000347	184:2	Lower half	51.7	43.8	47.8[QC:a]
S97T000357	184:4	Upper half	21	22	21.5[QC:a]
S97T000363		Lower half	9.9	10	9.95[QC:a]
S97T001370	184:6	Upper half	36.4	34.2	35.3
S97T000417		Lower half	13.2	13.1	13.1[QC:a]
S97T000429	184:6R	Lower half	23.1	26.7	24.9[QC:a]
S97T000442	184:6RA	Lower half	45.7	50.9	48.3[QC:a]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000277	183:1	Drainable liquid	9.33	8.93	9.13
S97T000287	183:3	Drainable liquid	<6.01	9.15	<7.58[QC:e,j]
S97T000288	183:4	Drainable liquid	9.25	6.74	8[QC:e,j]
S97T000289	183:5	Drainable liquid	13.2	7.8	10.5[QC:e,j]
S97T000290	183:7	Drainable liquid	11.4	16	13.7[QC:e,j]
S97T000341	184:1	Drainable liquid	6.21	6.54	6.38
S97T000351	184:2	Drainable liquid	<6.01	<6.01	<6.01
S97T000421	184:6	Drainable liquid	<6.01	<6.01	<6.01
S97T000445	184:6RA	Drainable liquid	8.83	8.5	8.66

Table B2-43. Tank 241-S-106 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T000307	183:4	Lower half	<5.72	<5.71	<5.71
S97T000686		Lower half	<5.64	<5.5	<5.57
S97T000308	183:5	Lower half	<5.74	<5.79	<5.77
S97T000309	183:7	Lower half	<5.77	<5.84	<5.8[QC:c]
S97T000685		Lower half	<5.87	<5.6	<5.73
S97T000319	183:8	Upper half	<5.79	6.75	<6.27
S97T000333		Lower half	<5.74	<5.83	<5.79
S97T000334	183:9	Upper half	<5.84	<5.72	<5.78
S97T000335		Lower half	<5.75	<5.84	<5.8[QC:c]
S97T000347	184:2	Lower half	13.3	13.3	13.3
S97T000357	184:4	Upper half	7.11	7.28	7.2
S97T000363		Lower half	<5.77	<5.81	<5.79
S97T001370	184:6	Upper half	10.7	11.8	11.3
S97T000417		Lower half	<5.62	<5.92	<5.77[QC:c]
S97T000429	184:6R	Lower half	<5.23	<5.5	<5.37
S97T000442	184:6RA	Lower half	<5.55	<5.67	<5.61
Liquids			µg/mL	µg/mL	µg/mL
S97T000277	183:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000287	183:3	Drainable liquid	<6.01	<6.01	<6.01
S97T000288	183:4	Drainable liquid	<6.01	<6.01	<6.01
S97T000289	183:5	Drainable liquid	<6.01	<6.01	<6.01
S97T000290	183:7	Drainable liquid	<6.01	<6.01	<6.01
S97T000341	184:1	Drainable liquid	<6.01	<6.01	<6.01
S97T000351	184:2	Drainable liquid	<6.01	<6.01	<6.01
S97T000421	184:6	Drainable liquid	<6.01	<6.01	<6.01
S97T000445	184:6RA	Drainable liquid	<6.01	<6.01	<6.01

Table B2-44. Tank 241-S-106 Analytical Results: Total Uranium, Laser Fluorimetry.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids:fusion			µg/g	µg/g	µg/g
S97T000305	183:5	Lower half	78.7	90.1	84.4
S97T000410	184:6	Upper half	369	380	375

Table B2-45. Tank 241-S-106 Analytical Results: Bromide (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000310	183:4	Lower half	1,220	1,170	1,190
S97T000311	183:5	Lower half	<1,020	<1,040	<1,030
S97T000312	183:7	Lower half	1,270	1,580	1,420[QC:e,j]
S97T000683		Lower half	<1,130	<1,100	<1,110
S97T000320	183:8	Upper half	<518	<517	<518
S97T000336		Lower half	611	565	588
S97T000684		Lower half	<1,880	<1,850	<1,860
S97T000337	183:9	Upper half	<1,010	<1,030	<1,020
S97T000338		Lower half	<1,020	<1,020	<1,020
S97T000348	184:2	Lower half	<1,020	<1,010	<1,010
S97T000358	184:4	Upper half	1,100	1,090	1,100
S97T000364		Lower half	1,090	1,060	1,070
S97T000412	184:6	Upper half	1,320	1,230	1,280
S97T000418		Lower half	1,540	1,600	1,570
S97T000430	184:6R	Lower half	1,870	1,800	1,830
S97T000443	184:6RA	Lower half	1,870	1,880	1,880
Liquids			µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	<644	<644	<644
S97T000283	183:3	Drainable liquid	918	909	913
S97T000284	183:4	Drainable liquid	2,980	2,790	2,890
S97T000285	183:5	Drainable liquid	<2,540	<2,540	<2,540
S97T000286	183:7	Drainable liquid	4,830	4,940	4,880
S97T000340	184:1	Drainable liquid	<518	<518	<518
S97T000350	184:2	Drainable liquid	<644	<644	<644
S97T000420	184:6	Drainable liquid	1,620	1,650	1,630
S97T000445	184:6RA	Drainable liquid	4,550	4,540	4,550

Table B2-46. Tank 241-S-106 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000310	183:4	Lower half	3,620	3,840	3,730
S97T000311	183:5	Lower half	4,010	3,870	3,940
S97T000312	183:7	Lower half	1,780	2,890	2,330[QC:e]
S97T000683		Lower half	2,260	2,170	2,210
S97T000320	183:8	Upper half	3,380	3,240	3,310
S97T000336		Lower half	3,230	2,420	2,820[QC:e]
S97T000684		Lower half	1,900	2,330	2,120[QC:e]
S97T000337	183:9	Upper half	2,710	2,480	2,590
S97T000338		Lower half	2,860	2,610	2,740
S97T000348	184:2	Lower half	3,490	1,860	2,680[QC:e]
S97T000358	184:4	Upper half	3,260	3,300	3,280
S97T000364		Lower half	2,600	2,620	2,610
S97T000412	184:6	Upper half	1,980	2,180	2,080
S97T000418		Lower half	1,610	1,510	1,560
S97T000430	184:6R	Lower half	2,060	2,010	2,030
S97T000443	184:6RA	Lower half	1,700	1,710	1,710
Liquids			µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	5,430	5,310	5,370
S97T000283	183:3	Drainable liquid	6,560	6,070	6,310
S97T000284	183:4	Drainable liquid	20,100	19,900	20,000
S97T000285	183:5	Drainable liquid	24,000	20,900	22,500
S97T000286	183:7	Drainable liquid	8,350	8,290	8,320
S97T000340	184:1	Drainable liquid	6,800	6,370	6,580
S97T000350	184:2	Drainable liquid	7,600	7,790	7,700
S97T000420	184:6	Drainable liquid	10,800	10,600	10,700
S97T000445	184:6RA	Drainable liquid	7,550	7,600	7,580

Table B2-47. Tank 241-S-106 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000310	183:4	Lower half	414	399	407
S97T000311	183:5	Lower half	311	329	320
S97T000312	183:7	Lower half	605	1,530	1,070[QC:e]
S97T000683		Lower half	1,580	885	1,230[QC:e]
S97T000320	183:8	Upper half	726	2,490	1,610[QC:e]
S97T000336		Lower half	635	558	597
S97T000684		Lower half	594	655	625
S97T000337	183:9	Upper half	1,300	1,620	1,460[QC:e]
S97T000338		Lower half	5,560	5,310	5,440
S97T000348	184:2	Lower half	503	602	552
S97T000358	184:4	Upper half	4,640	4,440	4,540
S97T000364		Lower half	652	643	647
S97T000412	184:6	Upper half	6,670	6,880	6,780
S97T000418		Lower half	3,670	4,090	3,880
S97T000430	184:6R	Lower half	2,790	2,370	2,580
S97T000443	184:6RA	Lower half	4,220	3,980	4,100
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000276	183:1	Drainable liquid	<244	<244	<244
S97T000283	183:3	Drainable liquid	<61.8	<61.8	<61.8
S97T000284	183:4	Drainable liquid	<244	<244	<244
S97T000285	183:5	Drainable liquid	<244	<244	<244
S97T000286	183:7	Drainable liquid	<244	<244	<244
S97T000340	184:1	Drainable liquid	<49.7	<49.7	<49.7
S97T000350	184:2	Drainable liquid	<61.8	<61.8	<61.8
S97T000420	184:6	Drainable liquid	<49.7	<49.7	<49.7
S97T000445	184:6RA	Drainable liquid	<61.8	<61.8	<61.8

Table B2-48. Tank 241-S-106 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000310	183:4	Lower half	3.02E+05	2.25E+05	2.64E+05[QC:e]
S97T000311	183:5	Lower half	1.67E+05	1.82E+05	1.75E+05
S97T000312	183:7	Lower half	2.17E+05	3.40E+05	2.78E+05[QC:d,e]
S97T000683		Lower half	4.40E+05	4.35E+05	4.37E+05[QC:c]
S97T000320	183:8	Upper half	3.39E+05	3.17E+05	3.28E+05
S97T000336		Lower half	3.99E+05	4.83E+05	4.41E+05
S97T000684		Lower half	5.29E+05	4.91E+05	5.10E+05
S97T000337	183:9	Upper half	3.98E+05	3.99E+05	3.98E+05
S97T000338		Lower half	1.75E+05	1.70E+05	1.73E+05
S97T000348	184:2	Lower half	6.39E+05	6.34E+05	6.37E+05
S97T000358	184:4	Upper half	2.06E+05	2.05E+05	2.05E+05
S97T000364		Lower half	4.06E+05	4.04E+05	4.05E+05
S97T000412	184:6	Upper half	1.95E+05	2.74E+05	2.35E+05[QC:e]
S97T000418		Lower half	4.36E+05	4.03E+05	4.20E+05[QC:c]
S97T000430	184:6R	Lower half	4.17E+05	4.54E+05	4.36E+05
S97T000443	184:6RA	Lower half	3.76E+05	4.07E+05	3.91E+05
Liquids			µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	1.77E+05	1.80E+05	1.79E+05
S97T000283	183:3	Drainable liquid	1.49E+05	1.40E+05	1.44E+05
S97T000284	183:4	Drainable liquid	4.07E+05	4.05E+05	4.06E+05
S97T000285	183:5	Drainable liquid	3.93E+05	3.48E+05	3.71E+05
S97T000286	183:7	Drainable liquid	1.80E+05	1.82E+05	1.81E+05
S97T000340	184:1	Drainable liquid	2.25E+05	2.10E+05	2.17E+05[QC:c]
S97T000350	184:2	Drainable liquid	2.32E+05	2.30E+05	2.31E+05
S97T000420	184:6	Drainable liquid	1.73E+05	1.74E+05	1.74E+05
S97T000445	184:6RA	Drainable liquid	2.21E+05	2.21E+05	2.21E+05

Table B2-49. Tank 241-S-106 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000310	183:4	Lower half	31,900	35,100	33,500
S97T000311	183:5	Lower half	37,400	35,500	36,400
S97T000312	183:7	Lower half	16,000	26,600	21,300[QC:d,e]
S97T000683		Lower half	22,100	22,100	22,100
S97T000320	183:8	Upper half	30,900	30,300	30,600
S97T000336		Lower half	29,500	21,200	25,400[QC:e]
S97T000684		Lower half	20,100	23,700	21,900
S97T000337	183:9	Upper half	26,200	23,800	25,000
S97T000338		Lower half	26,500	24,000	25,200
S97T000348	184:2	Lower half	13,500	14,600	14,000
S97T000358	184:4	Upper half	29,800	30,000	29,900
S97T000364		Lower half	25,700	25,600	25,600
S97T000412	184:6	Upper half	20,800	22,500	21,600
S97T000418		Lower half	14,800	15,500	15,200
S97T000430	184:6R	Lower half	19,000	17,800	18,400
S97T000443	184:6RA	Lower half	15,100	15,100	15,100
Liquids			µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	53,300	53,400	53,300
S97T000283	183:3	Drainable liquid	62,700	58,600	60,700
S97T000284	183:4	Drainable liquid	195,000	194,000	195,000
S97T000285	183:5	Drainable liquid	225,000	206,000	216,000
S97T000286	183:7	Drainable liquid	85,000	83,200	84,100
S97T000340	184:1	Drainable liquid	64,500	66,700	65,600[QC:c]
S97T000350	184:2	Drainable liquid	72,000	72,000	72,000
S97T000420	184:6	Drainable liquid	111,000	111,000	111,000
S97T000445	184:6RA	Drainable liquid	79,200	78,800	79,000

Table B2-50. Tank 241-S-106 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			μg/g	μg/g	μg/g
S97T000310	183:4	Lower half	4,720	7,430	6,070[QC:e]
S97T000311	183:5	Lower half	7,270	8,570	7,920
S97T000312	183:7	Lower half	9,090	12,000	10,500[QC:e]
S97T000683		Lower half	18,600	11,000	14,800[QC:e]
S97T000320	183:8	Upper half	7,350	22,400	14,900[QC:e]
S97T000336		Lower half	6,920	7,420	7,170
S97T000684		Lower half	4,990	7,370	6,180[QC:e]
S97T000337	183:9	Upper half	12,700	17,800	15,200[QC:e]
S97T000338		Lower half	61,600	51,000	56,300
S97T000348	184:2	Lower half	6,390	7,550	6,970
S97T000358	184:4	Upper half	33,200	30,400	31,800
S97T000364		Lower half	3,080	3,910	3,500[QC:e]
S97T000412	184:6	Upper half	61,800	69,900	65,800
S97T000418		Lower half	39,600	43,000	41,300
S97T000430	184:6R	Lower half	24,400	19,500	21,900[QC:e]
S97T000443	184:6RA	Lower half	43,100	39,500	41,300
Liquids			μg/mL	μg/mL	μg/mL
S97T000276	183:1	Drainable liquid	<2,440	<2,440	<2,440
S97T000283	183:3	Drainable liquid	1,940	1,890	1,910
S97T000284	183:4	Drainable liquid	<2,440	35,000	<18,700[QC:e]
S97T000285	183:5	Drainable liquid	<2,440	<2,440	<2,440
S97T000286	183:7	Drainable liquid	<2,440	3,360	<2,900[QC:e,j]
S97T000340	184:1	Drainable liquid	919	875	897
S97T000350	184:2	Drainable liquid	15,000	1,620	8,290[QC:e]
S97T000420	184:6	Drainable liquid	2,040	2,020	2,030
S97T000445	184:6RA	Drainable liquid	34,000	1,610	17,800[QC:e]

Table B2-51. Tank 241-S-106 Analytical Results: Sulfate (IC)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			μg/g	μg/g	μg/g
S97T000310	183:4	Lower half	9,280	11,100	10,200
S97T000311	183:5	Lower half	11,600	9,750	10,700
S97T000312	183:7	Lower half	2,650	3,330	2,990[QC:e,j]
S97T000683		Lower half	1,830	4,180	3,010[QC:e,j]
S97T000320	183:8	Upper half	9,850	9,990	9,920
S97T000336		Lower half	9,150	7,380	8,270[QC:e,j]
S97T000684		Lower half	7,480	5,640	6,560[QC:e,j]
S97T000337	183:9	Upper half	6,220	5,800	6,010
S97T000338		Lower half	5,600	5,650	5,620
S97T000348	184:2	Lower half	<2,770	3,570	<3,170[QC:e,j]
S97T000358	184:4	Upper half	26,400	25,200	25,800
S97T000364		Lower half	6,640	7,970	7,310
S97T000412	184:6	Upper half	12,100	13,500	12,800
S97T000418		Lower half	4,000	3,590	3,800
S97T000430	184:6R	Lower half	4,150	3,430	3,790
S97T000443	184:6RA	Lower half	5,410	4,860	5,140
Liquids			μg/mL	μg/mL	μg/mL
S97T000276	183:1	Drainable liquid	6,040	15,400	10,700[QC:e]
S97T000283	183:3	Drainable liquid	2,520	2,210	2,360
S97T000284	183:4	Drainable liquid	7,050	6,550	6,800
S97T000285	183:5	Drainable liquid	4,180	<2,800	<3,490[QC:e,j]
S97T000286	183:7	Drainable liquid	3,150	<2,800	<2,980
S97T000340	184:1	Drainable liquid	17,300	5,020	11,100[QC:c,e]
S97T000350	184:2	Drainable liquid	5,780	12,400	9,090[QC:e]
S97T000420	184:6	Drainable liquid	2,560	8,720	5,640[QC:e]
S97T000445	184:6RA	Drainable liquid	2,890	2,210	2,550[QC:e,j]

Table B2-52. Tank 241-S-106 Analytical Results: Oxalate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T000310	183:4	Lower half	1,060	1,440	1,250[QC:e,j]
S97T000311	183:5	Lower half	1,920	1,770	1,850
S97T000312	183:7	Lower half	<851	4,280	<2,570[QC:e,j]
S97T000683		Lower half	1,930	2,300	2,120
S97T000320	183:8	Upper half	8,480	8,650	8,570
S97T000336		Lower half	5,690	3,790	4,740[QC:e,j]
S97T000684		Lower half	5,210	5,930	5,570
S97T000337	183:9	Upper half	8,290	7,450	7,870
S97T000338		Lower half	12,900	11,800	12,300
S97T000348	184:2	Lower half	4,080	4,130	4,110
S97T000358	184:4	Upper half	11,500	11,500	11,500
S97T000364		Lower half	2,560	2,500	2,530
S97T000412	184:6	Upper half	5,430	5,870	5,650
S97T000418		Lower half	4,040	3,870	3,960
S97T000430	184:6R	Lower half	<854	<887	<871
S97T000443	184:6RA	Lower half	1,700	1,290	1,500[QC:e,j]
Liquids			µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	<2,130	<2,130	<2,130
S97T000283	183:3	Drainable liquid	912	790	851
S97T000284	183:4	Drainable liquid	<2,130	<2,130	<2,130
S97T000285	183:5	Drainable liquid	<2,130	<2,130	<2,130
S97T000286	183:7	Drainable liquid	<2,130	8,900	<5,520[QC:e,j]
S97T000340	184:1	Drainable liquid	<435	<435	<435
S97T000350	184:2	Drainable liquid	<541	<541	<541
S97T000420	184:6	Drainable liquid	<435	<435	<435
S97T000445	184:6RA	Drainable liquid	616	546	581

Table B2-53. Tank 241-S-106 Analytical Results: Bulk Density.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g/mL	g/mL	g/mL
S97T000303	183:7	Lower half	1.92	N/A	1.92
S97T000321	183:8	Lower half	1.73	N/A	1.73
S97T000323	183:9	Lower half	1.64	N/A	1.64
S97T000359	184:4	Lower half	1.81	N/A	1.81
S97T000425	184:6R	Lower half	1.58	N/A	1.58

Table B2-54. Tank 241-S-106 Analytical Results: Exotherm (DSC), Wet Basis.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Liquids			**J/g**	**J/g**	**J/g**	**J/g**
S97T000276RR	183:1	Drainable liquid	36.5	116		76.4[QC:e]
S97T000276	183:1	Drainable liquid	776	256		516[QC:e]
S97T000284	183:4	Drainable liquid	16.3	110		63.2[QC:e]
S97T000283	183:3	Drainable liquid	486	532		509[QC]
S97T000285RR	183:5	Drainable liquid	183	323		253[QC:e]
S97T000285	183:5	Drainable liquid	147	414		281[QC:e]
S97T000286RR	183:7	Drainable liquid	394	344		369
S97T000286		Drainable liquid	87.4	226		157[QC:e]
S97T000340	184:1	Drainable liquid	70.1	158		114[QC:e]
S97T000350	184:2	Drainable liquid	198	64.6		131[QC:e]
Solids			**J/g**	**J/g**	**J/g**	**J/g**
S97T000298RR	183:4	Lower half	50.7	4.8		27.8[QC:e]
S97T000298	183:4	Lower half	763	120		441[QC:e]
S97T000299	183:5	Lower half	222			222
S97T000300RR	183:7	Lower half	8.4	19.8	17.7	15.3[QC:e]
S97T000300	183:7	Lower half	135	371		253[QC:e]
S97T000316	183:8	Upper half	164	209		187
S97T000324		Lower half	183	138		160
S97T000325	183:9	Upper half	145	22.2		83.5[QC:e]
S97T000326		Lower half	124	133		128
S97T000344	184:2	Lower half	17.4	18.5		17.9
S97T000354	184:4	Upper half	10.4	23		16.7[QC:e]
S97T000360		Lower half	5.2	12.5		8.85[QC:e]
S97T000408	184:6	Upper half	132	136		134
S97T000414		Lower half	114	293		204[QC:e]

Table B2-55. Tank 241-S-106 Analytical Results: Gravimetric, Percent Water (Calculated from Percent Solids)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
S97T000316	183:8	Upper half	27.1	27.8	27.5
S97T000324		Lower half	25.4	23.7	24.5
S97T000325	183:9	Upper half	25.5	23.4	24.4
S97T000326		Lower half	36.3	36.1	36.2
S97T000354	184:4	Upper half	36.8	37.3	37
S97T000360		Lower half	25.7	24.8	25.3
S97T000408	184:6	Upper half	32.6	28	30.3
S97T000414		Lower half	24.9	23.8	24.4
S97T000426	184:6R	Lower half	24	24.1	24.1
S97T000439	184:6RA	Lower half	26.2	24.4	25.3

Table B2-56. Tank 241-S-106 Analytical Results: Percent Water (TGA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			%	%	%
S97T000276	183:1	Drainable liquid	53.6	54.5	54
S97T000283	183:3	Drainable liquid	58.7	52.4	55.6
S97T000284	183:4	Drainable liquid	55	54.1	54.5
S97T000285	183:5	Drainable liquid	52.6	52.8	52.7
S97T000286	183:7	Drainable liquid	53.3	53.8	53.5
S97T000340	184:1	Drainable liquid	54.8	55	54.9
S97T000350	184:2	Drainable liquid	54.8	55.7	55.2
S97T000420	184:6	Drainable liquid	52.2	51.9	52.1
S97T000445	184:6RA	Drainable liquid	52.4	52	52.2
Solids			%	%	%
S97T000298	183:4	Lower half	57	45.8	51.4
S97T000299	183:5	Lower half	40.6	23.3	32[QC:e]
S97T000300	183:7	Lower half	30.9	27.2	29.1
S97T000316	183:8	Upper half	27.2	29.4	28.3
S97T000324		Lower half	25.1	31.5	28.3
S97T000325	183:9	Upper half	28.1	30.7	29.4
S97T000326		Lower half	36.9	32.3	34.6
S97T000344	184:2	Lower half	31.3	34.8	33.1
S97T000354	184:4	Upper half	40.6	39.6	40.1
S97T000360		Lower half	37.5	31.2	34.3
S97T000408	184:6	Upper half	36.9	48.6	42.8
S97T000414		Lower half	36.6	34.1	35.3
S97T000426	184:6R	Lower half	28.8	36.2	32.5
S97T000439	184:6RA	Lower half	28.2	32.4	30.3

Table B2-57. Tank 241-S-106 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			unitless	unitless	unitless
S97T000276	183:1	Drainable liquid	1.4	1.43	1.41
S97T000283	183:3	Drainable liquid	1.4	1.4	1.4
S97T000284	183:4	Drainable liquid	1.44	1.44	1.44
S97T000285	183:5	Drainable liquid	1.48	1.47	1.47
S97T000286	183:7	Drainable liquid	1.43	1.42	1.42
S97T000340	184:1	Drainable liquid	1.39	1.39	1.39
S97T000350	184:2	Drainable liquid	1.39	1.39	1.39
S97T000420	184:6	Drainable liquid	1.52	1.53	1.52
S97T000445	184:6RA	Drainable liquid	1.42	1.39	1.4

Table B2-58. Tank 241-S-106 Analytical Results: Total Alpha.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S97T000277	183:1	Drainable liquid	<0.00793	<0.00653	<0.00723[QC:a,l]
S97T000287	183:3	Drainable liquid	<0.00933	<0.00933	<0.00933[QC:a,l]
S97T000288	183:4	Drainable liquid	<0.00793	<0.00913	<0.00853[QC:a,l]
S97T000289	183:5	Drainable liquid	<0.0107	<0.00933	<0.01[QC:a,l]
S97T000290	183:7	Drainable liquid	<0.00653	<0.00653	<0.00653[QC:a,l]
S97T000341	184:1	Drainable liquid	6.47E-04	4.21E-04	5.34E-04[QC:c,e]
S97T000351	184:2	Drainable liquid	0.00255	0.00261	0.00258
S97T000421	184:6	Drainable liquid	0.00262	0.00151	0.00207[QC:e]
S97T000445	184:6RA	Drainable liquid	0.00501	<0.0068	<0.00591[QC:e]
Solids: fusion			**µCi/g**	**µCi/g**	**µCi/g**
S97T000304	183:4	Lower half	0.0104	0.00861	0.00951
S97T000305	183:5	Lower half	0.0142	0.0213	0.0178[QC:e]
S97T000306	183:7	Lower half	0.0123	0.00997	0.0111[QC:e]
S97T000330	183:8	Lower half	0.0323	0.0368	0.0346
S97T000332	183:9	Lower half	0.0328	0.039	0.0359
S97T000346	184:2	Lower half	0.117	0.102	0.11
S97T000362	184:4	Lower half	0.0168	0.0178	0.0173
S97T000416	184:6	Lower half	0.0241	0.0382	0.0311[QC:e]
S97T000428	184:6R	Lower half	0.00721	<0.00983	<0.00852[QC:e]
S97T000441	184:6RA	Lower half	0.0153	<0.0109	<0.0131[QC:e]

Table B2-59. Tank 241-S-106 Analytical Results: Total Beta.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000305	183:5	Lower half	142	143	143
S97T000410	184:6	Upper half	131	120	126

Table B2-60. Tank 241-S-106 Analytical Results: Americium-241.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000304	183:4	Lower half	<0.984	<1.03	<1.01
S97T000305	183:5	Lower half	<1.07	<1.06	<1.07
S97T000306	183:7	Lower half	<0.921	<0.929	<0.925
S97T000318	183:8	Upper half	<0.558	<0.569	<0.564
S97T000330		Lower half	<0.37	<0.371	<0.37
S97T000331	183:9	Upper half	<0.346	<0.352	<0.349
S97T000332		Lower half	<0.506	<0.511	<0.508
S97T000346	184:2	Lower half	<0.46	<0.46	<0.46
S97T000356	184:4	Upper half	<0.619	<0.621	<0.62
S97T000362		Lower half	<0.6	<0.591	<0.596
S97T000410	184:6	Upper half	<0.601	<0.577	<0.589
S97T000416		Lower half	<0.524	<0.549	<0.537
S97T000428	184:6R	Lower half	<0.563	<0.607	<0.585
S97T000441	184:6RA	Lower half	<0.558	<0.513	<0.536

Table B2-61. Tank 241-S-106 Analytical Results: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000304	183:4	Lower half	124	131	128
S97T000305	183:5	Lower half	152	154	153
S97T000306	183:7	Lower half	109	109	109
S97T000318	183:8	Upper half	146	147	146
S97T000330		Lower half	127	129	128
S97T000331	183:9	Upper half	114	115	114
S97T000332		Lower half	114	118	116
S97T000346	184:2	Lower half	48.8	48.1	48.4
S97T000356	184:4	Upper half	90.7	89.3	90
S97T000362		Lower half	88.7	86	87.3
S97T000410	184:6	Upper half	89.5	85	87.3
S97T000416		Lower half	61.7	67.5	64.6
S97T000428	184:6R	Lower half	72.7	88.4	80.5
S97T000441	184:6RA	Lower half	68.5	57.5	63

Table B2-62. Tank 241-S-106 Analytical Results: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000304	183:4	Lower half	<0.0253	<0.0247	<0.025
S97T000305	183:5	Lower half	<0.0209	<0.0227	<0.0218
S97T000306	183:7	Lower half	<0.0212	<0.0195	<0.0204
S97T000318	183:8	Upper half	<0.035	<0.0346	<0.0348
S97T000330		Lower half	<0.0163	<0.0157	<0.016
S97T000331	183:9	Upper half	<0.0156	<0.0148	<0.0152
S97T000332		Lower half	<0.0278	<0.0352	<0.0315
S97T000346	184:2	Lower half	<0.0252	<0.0215	<0.0233
S97T000356	184:4	Upper half	<0.0211	<0.0224	<0.0217
S97T000362		Lower half	<0.0188	<0.0153	<0.017
S97T000410	184:6	Upper half	<0.0191	<0.0198	<0.0194
S97T000416		Lower half	<0.0196	<0.0254	<0.0225
S97T000428	184:6R	Lower half	<0.0137	<0.0155	<0.0146
S97T000441	184:6RA	Lower half	<0.0183	<0.0179	<0.0181

Table B2- 63. Tank 241-S-106 Analytical Results: Europium-154 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			μCi/g	μCi/g	μCi/g
S97T000304	183:4	Lower half	<0.0777	<0.0847	<0.0812
S97T000305	183:5	Lower half	<0.0831	<0.0587	<0.0709
S97T000306	183:7	Lower half	<0.0799	<0.0673	<0.0736
S97T000318	183:8	Upper half	<0.101	<0.0923	<0.0968
S97T000330		Lower half	<0.0505	<0.0533	<0.0519
S97T000331	183:9	Upper half	<0.0486	<0.0518	<0.0502
S97T000332		Lower half	<0.101	<0.101	<0.101
S97T000346	184:2	Lower half	<0.0915	<0.0944	<0.0929
S97T000356	184:4	Upper half	<0.0776	<0.0767	<0.0772
S97T000362		Lower half	<0.0529	<0.05	<0.0514
S97T000410	184:6	Upper half	<0.079	<0.0728	<0.0759
S97T000416		Lower half	<0.0902	<0.0861	<0.0881
S97T000428	184:6R	Lower half	<0.0566	<0.047	<0.0518
S97T000441	184:6RA	Lower half	<0.0542	<0.0475	<0.0509

Table B2-64. Tank 241-S-106 Analytical Results: Europium-155 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000304	183:4	Lower half	<0.375	<0.396	<0.386
S97T000305	183:5	Lower half	<0.412	<0.412	<0.412
S97T000306	183:7	Lower half	<0.349	<0.353	<0.351
S97T000318	183:8	Upper half	<0.278	<0.276	<0.277
S97T000330		Lower half	<0.179	<0.18	<0.18
S97T000331	183:9	Upper half	<0.168	<0.172	<0.17
S97T000332		Lower half	<0.251	<0.255	<0.253
S97T000346	184:2	Lower half	<0.221	<0.223	<0.222
S97T000356	184:4	Upper half	<0.296	<0.299	<0.297
S97T000362		Lower half	<0.29	<0.284	<0.287
S97T000410	184:6	Upper half	<0.231	<0.222	<0.227
S97T000416		Lower half	<0.258	<0.269	<0.264
S97T000428	184:6R	Lower half	<0.214	<0.233	<0.223
S97T000441	184:6RA	Lower half	<0.211	<0.193	<0.202

Table B2-65. Tank 241-S-106 Analytical Results: Strontium-89/90.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T000305	183:5	Lower half	1.97	1.98	1.98
S97T000410	184:6	Upper half	25.2	30.6	27.9

Table B2-66. Tank 241-S-106 Analytical Results: Total Organic Carbon (Furnace Oxidation Total Organic Carbon).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	2,730	1,820	2,280[QC:e]
S97T000283	183:3	Drainable liquid	2,150	2,030	2,090
S97T000284	183:4	Drainable liquid	2,570	2,280	2,430
S97T000285	183:5	Drainable liquid	2,610	2,100	2,360[QC:e]
S97T000286	183:7	Drainable liquid	1,620	1,650	1,640
S97T000340	184:1	Drainable liquid	1,650	1,460	1,560
S97T000350	184:2	Drainable liquid	1,530	1,500	1,520

Table B2-67. Tank 241-S-106 Analytical Results: Total Organic Carbon (Persulfate).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Solids			μg/g	μg/g	μg/g	μg/g
S97T000298	183:4	Lower half	1,530	944	1,550	1,340[QC:e]
S97T000299	183:5	Lower half	1,550	1,600		1,580
S97T000300	183:7	Lower half	1,030	1,200		1,120
S97T000316	183:8	Upper half	3,800	4,330		4,070
S97T000324		Lower half	2,830	2,790		2,810
S97T000325	183:9	Upper half	2,830	2,540		2,690
S97T000326		Lower half	4,310	4,380		4,350[QC:d]
S97T000344	184:2	Lower half	1,910	1,940		1,930
S97T000354	184:4	Upper half	3,600	3,360		3,480
S97T000360		Lower half	1,220	1,240		1,230
S97T000408	184:6	Upper half	2,180	2,320		2,250
S97T000414		Lower half	1,660	1,770	1,600	1,680
S97T000426	184:6R	Lower half	885	675	831	797[QC:e]
S97T000439	184:6RA	Lower half	1,150	1,140		1,150
Liquids			μg/mL	μg/mL	μg/mL	μg/mL
S97T000276	183:1	Drainable liquid	1,190	1,030		1,110
S97T000283	183:3	Drainable liquid	729	880		805
S97T000284	183:4	Drainable liquid	936	881	1,580	1,130
S97T000285	183:5	Drainable liquid	1,090	1,040		1,070
S97T000286	183:7	Drainable liquid	1,430	1,460		1,450
S97T000340	184:1	Drainable liquid	979	1,070		1,020
S97T000350	184:2	Drainable liquid	950	1,050		1,000
S97T000421	184:6	Drainable liquid	1,680	1,620		1,650
S97T000445	184:6RA	Drainable liquid	1,400	1,640		1,520

Table B2-68. Tank 241-S-106 Analytical Results: Total Inorganic Carbon (Persulfate).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Solids			µg/g	µg/g	µg/g	µg/g
S97T000298	183:4	Lower half	8,800	3,460	6,940	6,400[QC:e]
S97T000299	183:5	Lower half	14,700	16,600		15,700
S97T000300	183:7	Lower half	5,240	4,510		4,880
S97T000316	183:8	Upper half	5,050	5,790		5,420
S97T000324		Lower half	7,610	4,310	4,630	5,520[QC:e]
S97T000325	183:9	Upper half	5,330	4,730		5,030
S97T000326		Lower half	4,870	4,060		4,470
S97T000344	184:2	Lower half	1,430	1,900	1,490	1,610[QC:e]
S97T000354	184:4	Upper half	20,800	19,000		19,900
S97T000360		Lower half	4,090	5,150		4,620[QC:e]
S97T000408	184:6	Upper half	6,110	6,220		6,170
S97T000414		Lower half	3,750	3,000	2,960	3,240[QC:e]
S97T000426	184:6R	Lower half	4,400	2,940	4,560	3,970[QC:c,e]
S97T000439	184:6RA	Lower half	4,280	7,570	4,810	5,550[QC:e]
Liquids			µg/mL	µg/mL	µg/mL	µg/mL
S97T000276	183:1	Drainable liquid	4,380	4,780		4,580
S97T000283	183:3	Drainable liquid	2,560	2,260		2,410
S97T000284	183:4	Drainable liquid	1,800	2,410	2,810	2,340[QC:e]
S97T000285	183:5	Drainable liquid	1,660	1,490		1,580
S97T000286	183:7	Drainable liquid	2,780	2,630		2,710
S97T000340	184:1	Drainable liquid	5,530	5,770		5,650
S97T000350	184:2	Drainable liquid	5,530	5,340		5,440
S97T000421	184:6	Drainable liquid	2,480	2,410		2,450
S97T000445	184:6RA	Drainable liquid	2,660	3,130		2,900

B2.2 DESCRIPTION OF RETAINED GAS AND BUBBLE RETENTION ANALYSES

Bubble retention analyses were performed on subsamples from the push mode core sampling event. The analyses were performed in accordance with Rassat (1997), but the results were not available when this tank characterization report was written. Results will be reported in a separate document.

Results of the retained gas analyses were presented in Mahoney et al. (1997). The retained gas sampler is a modified version of the core sampler used at the Hanford Site. It is designed to be used with the gas extraction equipment in the hot cell to capture and extrude a gas-containing waste sample in a hermetically sealed system. The retained gases are then extracted and stored in small gas canisters. The composition of the gases contained in the canisters is measured by mass spectroscopy. The total gas volume in the sample is obtained from analyzing the extraction process.

The retained gas inventories calculated from the local measurements of gas volume fraction made by the retained gas sampler can differ significantly from the total gas inventories estimated by the barometric pressure effect or surface level rise methods. These discrepancies occur together with irregular waste layers and other strong indications of lateral inhomogeneity in the waste. Because the retained gas samples are localized, they capture little of this variation. Therefore, the barometric pressure effect or surface level rise methods, which are related to the overall gas in the tank, must be used to supplement retained gas sampler measurements in estimating the gas inventories in high-waste-variability tanks.

In tank 241-S-106, the waste consisted of two distinct layers: an upper liquid layer ranging from 40 to 200 cm (16 to 79 in.) in thickness and a lower, high-solids, saltcake layer ranging from 260 to 420 cm (102 to 165 in.) in thickness. There was also a thick, dry crust around the perimeter of the tank. The waste properties were not consistent between the two risers, suggesting that the waste was not laterally uniform in the tank.

The retained gas sampler was used in risers 7 and 8 to sample four segments, two from each riser. Both risers were near the tank center. There were no retained gas samples from either the perimeter crust or the upper liquid layer. Such sampling was attempted but was not successful because of hard waste and sampler valve closure problems.

Retained gas measurements and estimated solubilities showed three major low-solubility constituents in the gas/vapor phase (free gas) of the high-solids layer: 24 mol% nitrogen, 63 mol% hydrogen, and 11 mol% nitrous oxide. The remainder of the gas content was comprised of ammonia, methane, and other hydrocarbons. The drill-string gas had an H_2/N_2O ratio of 4.0, somewhat lower than the average retained gas sampler value of 5.7 from riser 7. The measured local ammonia concentrations ranged from 1,100 to 6,200 μmol/L of waste, and more than 99.7 percent of the ammonia was dissolved in the liquid.

Based on the estimated solubilities and retained gas sample measurements of gas concentrations, about 10 percent by volume (in-situ) of the high-solids layer was filled with free gas. The in-situ gas volume fraction ranged between 7.3 and 14 percent. Because of the waste variability from one riser to another and the availability of only two retained gas samples from each riser, the best estimate of the total gas inventory was considered to be that based on the barometric pressure effect method, 410 $\pm$130m^3 at in-situ conditions, or 580 $\pm$190m^3 at standard temperature and pressure. By comparison, the inventory estimated from the RGS data was 230 $\pm$120m^3 standard temperature and pressure. The retained gas sampling inventory was smaller than the barometric pressure effect inventory, perhaps because the retained gas sampling inventory was biased by samples being taken only near the tank center.

Table B2-69 contains the composition of the gas/vapor phase in each sample and the integrated average composition for the high-solids layer.

Table B2-69. Sample and Overall Average Compositions of Retained Gas with Gas Entrainment Correction.

Riser: Segment	N_2 (mol%)	H_2 (mol%)	N_2O (mol%)	NH_3 (mol%)	Other (mol%)
7:3	32 ±4.0	59 ±6.8	8.1 ±1.0	0.027 ±0.009	0.64 ±0.29
7:5	22 ±3.0	62 ±6.9	15 ±1.6	0.38 ±0.11	0.51 ±0.28
8:6	25 ±4.0	63 ±9.6	11 ±1.8	0.10 ±0.032	1.4 ±0.98
8:10	23 ±2.4	65 ±4.6	11 ±0.8	0.095 ±0.025	0.52 ±0.27
Average in the high-solids layer[1]	24 ±3.0	63 ±6.3	11 ±1.2	0.14 ±0.02	0.73 ±0.43

Note:

[1] The error bands on the average composition, as for the individual sample concentrations, only represent the instrument error because there are too few samples to define the spatial variability of gas concentration.

B2.3 VAPOR PHASE MEASUREMENT

Vapor sampling and combustible gas testing were completed on June 13, 1996, to support the hazardous vapor screening DQO (Osborne and Buckley 1995) and the organic solvents DQO (Meacham et al. 1997). Results are shown in Tables B2-70 and B2-71.

In addition to the 1996 samples, headspace combustible gas measurements were obtained during the February 12 to March 21 push mode sampling of tank 241-S-106. These measurements were taken to determine the LFL for the tank headspace at the time of sampling, and to ensure safe operating conditions during sampling. Because of high LFL readings in the drill string, argon gas was added to lower the LFL during sampling. Results of vapor phase measurements taken in the headspace of the tank and at the drill string are summarized in Table B2-70.

Table B2-70. Results of Combustible Gas Tests for Tank 241-S-106.

Measurement	June 13, 1996[1]	February to March 1997 (During Push Sampling Event)
LFL, headspace	0%	0 to 1%
LFL, drill string (Argon purge was used)	n/a	R7: Exceeded instrument range for segments 6 and 6A. R8: up to 61% after segment 8
NH_3	100 ppmv	0 to 50 ppmv
O_2	21.0%	20.8 to 21.0%
TOC	7.8 ppmv	0 to 2.9 ppmv
N_2O	0%	n/a

Note:

[1]Caprio (1996)

Table B2-71. Results of June 13, 1996 Headspace Vapor Sample Measurements.[1]

Category	Sample Medium	Analyte	Concentration	Units
Inorganic Analytes	Sorbent Traps	NH_3	36.5±3.4	ppmv
		NO_2	<0.16	ppmv
		NO	<0.16	ppmv
		H_2O	8.9 ±0.3	mg/L
Permanent Gases	SUMMA[2] Canister	H_2	<17	ppmv
		CH_4	<25	ppmv
		CO_2	<17	ppmv
		CO	<17	ppmv
		N2O	<17	ppmv
TNMOC	SUMMA™ Canister	TNMOC	1.82	mg/m^3
Organics	SUMMA™ Canister	Methanol	2.65	ppmv
		Ethanol	1.38	ppmv
		Acetone	0.221	ppmv
Organics	Sorbent Traps	Methanol	0.747	ppmv
		Ethanol	0.604	ppmv
		Methycyclohexane	0.314	ppmv

Notes:

TNMOC = total nonmethane organic compounds

[1]Evans et al. (1997)
[2]SUMMA is a trademark of Molectrics, Inc., Cleveland, Ohio.

B2.4 DESCRIPTION OF HISTORICAL SAMPLING EVENTS AND ANALYTICAL RESULTS

Analyses of sampling events for tank 241-S-106 were obtained from historical records. The results of grab sampling events in January 1992 and June 1975 are shown in Tables B2-72 to B2-74. The 1975 data have not been validated and should be used with caution. For each event, the primary constituents and any mentioned techniques are noted. Supernatant was removed from tank 241-S-106 from 1973 to 1975, and the tank received evaporator slurry during this time. As a result, pre-1975 samples do not represent current tank contents and are not included in this report. Refer to Appendix E for pre-1975 historical sample information.

B2.4.1 January 1992 Sampling Event and Analytical Result Summary Tables

Two 100 mL grab samples (6S1091-1 and 6S1091-R) were taken from tank 241-S-106 in January 1992 and were delivered to the laboratory on January 28, 1992. The samples were taken at the bottom of the salt well screen according to procedure TO-080-030 (Pitkoff 1991). Sample results are shown in Table B2-72 (Pitkoff 1992).

B2.4.2 June 1975 Sampling Event and Analytical Result Summary Tables

A sample was taken from tank 241-S-106 on June 4, 1975 (Horton 1975). The sample contained a solid phase and a liquid phase. Information was unavailable about the handling of the samples. Analyses of the June sampling event for tank 241-S-106 are shown in Tables B2-73 and B2-74. The sample was separated by centrifuge, and the resultant liquid and solid phases were analyzed. The results of each phase indicate the waste contained primarily sodium salts, and both phases containing mostly sodium nitrate. The radionuclides analyzed in the sample were strontium and cesium.

Table B2-72. January 1992 Tank 241-S-106 Grab Sample.[1] (3 sheets)

Received: January 28, 1992		
Component	**Lab Value**	**Lab Unit**
Physical Data		
Visual	Thick yellow liquid/clear, <10% solids. Solids grayish and granular, no visible organic layer.	
Specific gravity	1.411	n/a
DSC	Exotherm 240 to 440 °C (464 to 824 °F)	
pH	13.36	n/a
Chemical Analysis		
TOC	1.50	g/L
TIC	4.47	g/L
NH_4	171	ppm
OH^-	3.04	*M*

Table B2-72. January 1992 Tank 241-S-106 Grab Sample.[1] (3 sheets)

Received: January 28, 1992		
Component	Lab Value	Lab Unit
Chemical Analysis (Cont'd)		
U	0.00235	g/L
F	<111	ppm
Cl	6,590	ppm
NO_3	165,000	ppm
PO_4	1,630	ppm
SO_4	4,080	ppm
NO_2	65,100	ppm
CN	20.2	ppm
As	0.250	ppm
Se	0.243 6,500	ppm μg/L
Hg	<0.020	ppm
Zr	675	μg/L
Bi	<1,800	μg/L
Al	3.02E+07	μg/L
Zn	<200	μg/L
Cu	5,100	μg/L
Fe	2,980	μg/L
Ca	43,700	μg/L
Cr	8.65E+06	μg/L
Ba	495	μg/L
P	460,000	μg/L
Mg	9,500	μg/L
As	<1,350	μg/L
Mo	52,000	μg/L
Ag	<400	μg/L
Pb	<4,400	μg/L
Ti	<150	μg/L
Cd	<200	μg/L

Table B2-72. January 1992 Tank 241-S-106 Grab Sample.[1] (3 sheets)

Received: January 28, 1992		
Component	**Lab Value**	**Lab Unit**
Chemical Analysis (Cont'd)		
K	1.41E+06	µg/L
Mn	297	µg/L
Na	2.13E+08	µg/L
Si	4,520	µg/L
Radiological Analysis		
$^{239/240}Pu$	<0.0682	µCi/L
^{137}Cs	2.05E+05	µCi/L
^{241}Am	0.330	µCi/L
^{237}Np	0.451	µCi/L
^{99}Tc	193	µCi/L
^{129}I	<0.0329	µCi/L
^{3}H	1.87	µCi/L
^{14}C	2.38	µCi/L
^{79}Se	0.571	µCi/L
^{90}Sr	109	µCi/L

Note:

[1]Pitkoff (1992)

Table B2-73. Tank 241-S-106 Solid Sample[1]

Waste Tank 241-S-106 Analyses of 106-S Tank Solids July 23, 1975		
Received: June 4, 1975		
Component	Lab Value	Lab Unit
Physical Data		
Visual	Salt solids were very fine / Salt crystals were yellow	
Bulk Density	1.59	g/cc
H_2O	29.1	%
Chemical Analysis		
$NaAlO_2$	4.7	%
NaOH	6.2	%
$NaNO_2$	4.5	%
$NaNO_3$	39.5	%
Na_2CO_3	10.1	%
Na_3PO_4	2.4	%
Al_2O_3	0.1	%
FeOOH	0.2	%
Total Wt% Recovery	96.80	%
Radiological Analysis		
Pu	2.71×10^{-5}	g/g
^{137}Cs	200	μCi/g
$^{89+90}Sr$	0.69	μCi/g

Note:

[1]Pre-1989 analytical data have not been validated and should be used with caution.

Table B2-74. Tank 241-S-106 Liquid Sample[1]

Waste Tank 241-S-106 Analyses of 106-S Supernatant Liquid July 23, 1975		
Received: June 4, 1975		
Component	Lab Value (M)	Lab Value (%)
Physical Data		
Density	1.45	
H_2O	50.0%	
Chemical Analysis		
$NaNO_2$	1.78	8.5
$NaAlO_2$	1.85	10.5
$NaNO_3$	2.42	14.2
NaOH	4.44	12.2
Na_2CO_3	0.27	1.9
Na_3PO_4	0.028	0.3
Total wt% recovery	---	98.3
Radiological Analysis		
Pu	1.17×10^{-6}	g/L
^{137}Cs	5.29×10^{5}	µCi/L
$^{89+90}Sr$	1.22×10^{3}	µCi/L
^{134}Cs	2.02×10^{3}	µCi/L

Note:

[1]Pre-1989 analytical data have not been validated and should be used with caution.

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

This section discusses the overall quality and consistency of the current sampling results for tank 241-S-106 and provides the results of an analytical-based inventory calculation.

This section also evaluates sampling and analysis factors that may impact data interpretation. These factors are used to assess overall data quality and consistency and to identify limitations in data use.

B3.1 FIELD OBSERVATIONS

Sample recovery during the push mode sampling event was mixed. Essentially complete segments through the entire depth of waste were recovered for the 10 segments collected from core 183 (riser 8). Because of the difficulty of penetrating the hard solids using push mode sampling, only 6 of 10 segments from core 184 (riser 7) had complete recoveries. Because samples could not be obtained from the bottom four segments of core 184, an attempt was made to collect samples from riser 14. The collection of samples from riser 14 (core 187) was also abandoned because of the difficulty of penetrating the hard solids using push mode sampling.

Cores 183 and 184 were obtained from the center of the tank, but nothing was collected from riser 14, which is nearer the tank's northeastern side wall. A question may be raised regarding the representativeness of the samples for the entire waste in the tank. In tank photographs showed the waste sloped down significantly from the side wall of the tank. Therefore, it appears that the full depth of the waste was partially sampled, and the sampling and analysis plan (Buckley 1997) requirement that vertical profiles of the waste be obtained from two risers was not met.

B3.2 QUALITY CONTROL ASSESSMENT

The usual QC assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. All pertinent QC tests were conducted on 1997 push mode core samples, allowing a full assessment regarding the accuracy and precision of the data. Buckley (1997) established specific acceptance criteria for all required analytes. Sample and duplicate pairs with one or more QC results outside the specified criteria, were identified by footnotes in the data summary tables.

The standard and spike recovery results provide an estimate of analysis accuracy. If a standard or spike recovery was above or below the given acceptance criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the RPD, which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100.

The RPDs for eight of 19 subsamples were outside the specified acceptance limits level for total alpha activity. This variability may have been caused in part by sample homogeneity problems but is mainly attributed to the proximity of sample alpha activities to the minimum detectable activity, near which the variability is expected to be greater. Accuracy was acceptable with only one spike (biased low) exceeding the acceptance limit. Insignificant contamination of the blanks was observed. Reruns were deemed unnecessary as the sample results were far below the action limit. The divergence from the specified acceptance requirements mentioned here and footnoted in the data summary tables should not impact data validity or use.

Total beta analyses were fully within acceptance limits. Insignificant contamination of the blanks was observed. These data are valid and usable.

Strontium-89/90 were fully within specified acceptance limits and the carrier recoveries were acceptable. These data are valid and usable.

The RPDs for GEA analytes were within acceptance limits for all samples except for three samples for ^{60}Co and one sample for ^{154}Eu. This degree of variability is normal and expected when sample activities are less than the minimum detectable activity, as was the case. Cesium-137 was detected in three of four preparation blanks, but the activities were insignificant relative to the sample activities. The divergence from the specified acceptance requirements mentioned here and footnoted in the data summary tables does not impact data validity or its use.

The RPD for five of the 24 samples analyzed for TGA exceeded the acceptance limit. This variability was attributed to sample inhomogeneity. For the solid samples, percent water values can be compared between the TGA procedure and the gravimetric procedure. These determinations of percent water are believed to be valid and usable.

Although the standard recoveries for DSC were within acceptance limits, indicating that the analytical system was functioning correctly, the analytical results are difficult to interpret because of inconsistencies. Six of the 24 samples analyzed initially had results that exceeded the notification limit. Of these six samples, two (S97T000276 and S97T000298) were analyzed two additional times. The results of the first rerun for both samples were less than the notification limit, and the second rerun yielded no exotherms. The scientist's explanation of these phenomena indicated that quantitation (integration) of the exothermic peaks was subjective because the initial thermogram trace of exothermic peaks for some of the samples did not return to a high-end baseline before the end of the run. No determination was made regarding the cause of the variability (for example, sample degradation in time and sample inhomogeneity) in results from one run to the next. Relative percent difference acceptance limits were exceeded for 19 of the 31 analyses performed. This variability was attributed to visible sample inhomogeniety and to the difficulty of baseline integration. Caution should be used in interpreting these data because of quantification subjectivity, and usability of data should be determined by the user based on examination of the raw data (thermograms) on a case-by-case basis.

Standard recoveries and RPDs for specific gravity analyses appeared to be good; however no acceptance criteria were specified. These data appeared to be consistent, valid, and usable.

Of the 37 metals quantified by ICP, only eight were DQO required analytes. The quality of non-required analytes is discussed in Section B2.1.3.8. Of the eight required analytes (Li, Al, Bi, Ca, Fe, P, Na and Cr) only iron had standard recoveries that exceeded the sampling and analysis plan specified acceptance limits of 80 to 120 percent. These data were not out of control based on the control limits specified in the 222-S Laboratory Quality Assurance Program (Markel 1997), where the limits were determined by a statistical evaluation of historical laboratory control standard (LCS) analytical results. High RPDs were observed for five of the required analytes (Bi, Ca, Fe, Li, and P) for solid samples. The variability in these results was attributed to the proximity of the sample analyte concentrations to their respective detection limits (where greater variability is normal and is expected) and/or to sample inhomogeneity. Although spike recoveries exceeded acceptance limits for some samples for aluminum, chromium, iron, phosphorus and sodium, the cause is attributed to very high concentrations of these analytes in the samples. (Samples cannot be spiked to levels much greater than already present.) The serial dilution analyses, which were used to evaluate accuracy when analyte concentrations are very high and spikes fail, indicate that quantitation of these analytes was acceptable. Some blank contamination was observed, but the levels were insignificant relative to the sample analyte concentrations. The divergence from the specified acceptance requirements mentioned here and footnoted in the data summary tables should not impact data validity or its use.

Of the eight anions quantified by IC, only three (bromide, nitrate and sulfate) were DQO-required analytes. The quality of non-required analytes is discussed in Section B2.1.3.9. The cause for high RPDs for IC analytes was attributed to sample inhomogeneity and proximity of analyte concentrations to their respective detection limits. Spike recovery failures were generally attributed to sample inhomogeneity. For nitrate, recovery failure was also attributed to the technical difficulty of quantifying spiked samples where the sample concentrations are already very high. Low levels of contamination were observed in the preparation blanks but were determined to be insignificant relative to the sample analyte concentrations. The divergence from the specified acceptance requirements mentioned here and footnoted in the data summary tables does not impact data validity or its use.

All quality control parameters for total uranium were within acceptance limits, and sample concentrations are considered valid and usable.

Sample inhomogeneity was noted as the likely cause of imprecision for TIC analyses, where eight of 23 duplicate samples had RPDs that exceeded acceptance limits. Reruns produced similar results. Standard and spike recoveries were within acceptance limits. These data are valid and usable.

High RPDs were observed for two of 22 TOC analyses performed. Reruns of these samples yielded comparable results, indicating that sample inhomogeneity was a factor. Standard and spike recoveries were within acceptance limits. These data are valid and usable.

B3.3 DATA CONSISTENCY CHECKS

Comparing different analytical methods is helpful in assessing the consistency and quality of the data. Several comparisons were possible with these data:

- Sulfur analyzed by ICP versus sulfate analyzed by IC
- Phosphorous analyzed by ICP versus phosphate analyzed by IC
- Weight percent water by TGA versus weight percent water by gravimetry
- Total organic carbon by furnace oxidation versus TOC by persulfate oxidation
- Energetics by DSC and TOC
- Total uranium by laser induced kinetic phosphorescence versus total uranium by ICP
- TOC versus oxalate

In addition, mass and charge balances were calculated to help assess the overall data consistency.

B3.3.1 Comparison of Results from Different Analytical Methods

The following data consistency checks compare the results from two analytical methods. Agreement between the two methods strengthens the credibility of both results, but poor agreement brings the reliability of the data into question. All analytical mean results were taken from Section B2.0 tables.

B3.3.1.1 Sulfate in Solids. The analytical sulfur mean result as determined by ICP was 2,440 μg/g which converts to 7,320 μg/g of sulfate. This compared well with the IC sulfate mean result of 7,790. The RPD between these two phosphate results was 6.0 percent. Consequently, sulfur is determined to be 100 percent soluble.

B3.3.1.2 Phosphate in Solids. The analytical phosphorous mean result as determined by ICP was 6,690 μg/g which converts to 20,500 μg/g of phosphate. This compared well with the IC phosphate mean result of 22,100 μg/g. The RPD between these two phosphate results was 7.2 percent. Consequently, phosphorous is determined to be 100 percent soluble.

B3.3.1.3 Percent Water in Solids. Table B2-55 show results for gravimetric percent water and TGA percent water analyses. The relative percent difference in sample results for the two methods ranges between 2.8 and 30.9 percent with an average RPD of 17.5. Except for core 183, segment 9 lower half, all gravimetric results were lower than the TGA results.

B3.3.1.4 Total Organic Carbon in Solids. Tables B2-66 and B2-67 show analytical results for TOC by furnace oxidation methods and TOC by persulfate oxidation. Total organic carbon by furnace oxidation was only conducted on drainable liquids, where DSC results exceeded 430 J/g. A comparison of samples showed that the RPD for analytical results using the two methods ranged from 13.1 to 160 percent. For all samples, TOC results by furnace oxidation were higher than TOC by persulfate.

B3.3.1.5 Total Uranium in Solids. Total uranium by ICP was lower than detection limits (<321 μg/g). Total uranium by kinetic phosphorescence results were respectfully 84.4 μg/g and 375 μg/g for core 183, segment 5 lower half and core 184 segment 6 upper half.

B3.3.1.6 Total Organic Carbon and Oxalate in Solids. The mean concentration of TOC in solids was 2,090 μg C/g. A mean oxalate value of 1,930 μg/g yields a carbon value of 1,930 μg C/g. This indicates that most of the TOC is present as oxalate.

B3.3.2 Mass and Charge Balance

The principal objective in performing mass and charge balances is to determine whether the measurements are consistent. In calculating the balances, only the analytes listed in Section B2.0, which were detected at a concentration of 1,000 μg/g or greater were considered.

Except sodium, all cations listed in Table B3-1 and B3-3 were assumed to be in their most common hydroxide or oxide form, and the concentrations of the assumed species were calculated stoichiometrically. Because precipitates are neutral species, all positive charge was attributed to the sodium cation. The anions listed in Tables B3-2 and B3-4 were assumed to be present as sodium salts and were expected to balance the positive charge exhibited by the cations. Phosphate and sulfate, as determined by IC, are assumed to be completely water soluble and appear only in the anion mass and charge calculations.

B3.3.2.1 Solids Mass and Charge Balance. The solids mass balance was calculated from the formula below. The factor 0.0001 is the conversion factor from μg/g to weight percent.

Mass balance = % water + 0.0001 x {Total Analyte Concentration}

= % water + 0.0001 x {AlO_2^- + $Cr_2O_7^{2-}$ + Na^+ +Cl- + F^- + NO_3^- + NO_2^- + PO_4^{-3} + SO_4^{2-} + $C_2O_4^{2-}$ + CO_3^{2-}}

The total solids analyte concentration calculated from the above equation is 716,930 μg/g. The mean weight percent water (obtained from the gravimetric analyses reported in Table B3-6) is 27.9 percent or 279,000 μg/g. The mass balance resulting from adding the percent water to the total analyte concentration is 99.6 percent (see Table B3-3).

Table B3-1. Cation Mass and Charge Data (Solids).

Analyte	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μ eq/g)
Sodium	2.05E+05	Na^+	2.05E +05	8,920
Total:			2.05E +05	8,920

Table B3-2. Anion Mass and Charge Data (Solids).

Analyte	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μ eq/g)
Aluminum	16,500	AlO_2^-	36,100	612
Chloride	2,630	Cl^-	2,630	74.1
Chromium	5,300	$Cr_2O_7^{2-}$	22,000	204
Fluoride	2,300	F^-	2,300	121
Nitrate	3.58E+05	NO_3^-	3.58E+05	5,040
Nitrite	23,600	NO_2^-	23,600	429
Oxalate	4,510	$C_2O_4^{2-}$	4,510	103
Phosphate	22,100	PO_4^{3-}	22,100	698
Sulfate	7,790	SO_4^{2-}	7,790	162
TIC	6,590	CO_3^{2-}	32,900	1,100
Total:			511,930	8,543

The following equations demonstrate the derivation of total cations and total anions; the charge balance is the ratio of these two values.

Total cations (μeq/g) = $[Na^+]/23.0 = 8{,}920$ μeq/g

Total anions (μeq/g) = $[AlO_2^-]/59 + [Cl^-]/35.5 + [Cr_2O_7^{2-}]/108 + [F^-]/19.0 + [NO2-]/55 + [NO_3^-]/62.0 + [C_2O_4^{2-}]/38 + [PO_4^{-3}]/31.7 + [SO_4^-]/48.1 + [CO_3^{2-}]/30 = 8{,}543$ μeq/g

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge is 1.04.

B3.3.2.1 Drainable Liquid Mass and Charge Balance. The drainable liquid mass balance was calculated from the formula below. The factor 0.0001 is the conversion factor from μg/g to weight percent.

Mass balance = % water + 0.0001 x {Total Analyte Concentration}

= % water + 0.0001 x $\{AlO_2^- + Cr_2O_7^{2-} + Na^+ + Cl- + F^- + NO_3^- + NO_2^- + PO_4^{-3} + SO_4^{2-} + C_2O_4^{2-} + CO_3^{2-}\}$ / 1.43

The total drainable liquid analyte concentration calculated from the above equation is 530,000 μg/g. The mean weight percent water (Table B3-7) is 53.8 percent or 538,000 μg/g. The mass balance resulting from adding the percent water to the total analyte concentration is 107 percent (see Table B3-3).

Table B3-3. Cation Mass and Charge Data (Drainable Liquid).

Analyte	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μ eq/g)
Sodium	1.71E+05	Na^+	1.71E +05	7,430
Total:			1.71E +05	7,430

Table B3-4. Anion Mass and Charge Data (Drainable Liquid).

Analyte	Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μeq/g)
Aluminum	26,900	AlO_2^-	58,800	997
Chloride	7,760	Cl^-	7,760	219
Chromium	6,580	$Cr_2O_7^{2-}$	27,300	253
Nitrate	1.68E+05	NO_3^-	1.68E+05	2,710
Nitrite	76,200	NO_2^-	76,200	1,390
Oxalate	<1,150	$C_2O_4^{-2}$	<1,150	<30
Phosphate	4,460	PO_4^{3-}	4,460	141
Sulfate	4,010	SO_4^{2-}	4,010	105
TIC	2,200	CO_3^{2-}	11,000	367
Total:			3.59E+05	6,212

The following equations demonstrate the derivation of total cations and total anions; the charge balance is the ratio of these two values.

Total cations (μeq/g) = $[Na^+]/23.0 = 7{,}430\ \mu eq/g$

Total anions (μeq/g) = $[AlO_2^-]/59 + [Cl^-]/35.5 + [Cr_2O_7^{2-}]/108 + [F^-]/19.0 + [NO2^-]/55 + [NO_3^-]/62.0 + [C_2O_4^{2-}]/38 + [PO_4^{-3}]/31.7 + [SO_4^-]/48.1 + [CO_3^{2-}]/30 = 6{,}212\ \mu eq/g$

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge is 1.20. The difference in the positive and negative charges for the drainable liquid samples is attributed to hydroxide based on January 1992 grab sample results that showed a hydroxide value of 3.04*M* or 36,000 μg/g. This equates to a negative hydroxide charge of 2,120 μeq/g.

B3.3.2.2 Mass and Charge Balance Summary. In summary, the above calculations yield reasonable mass and charge balance values (close to 1.00 for charge balance and 100 percent for mass balance), indicating that the analytical results are generally consistent.

Table B3-5. Mass and Charge Balance Totals.

Totals	Concentrations (μg/g)	Charge (μeq/g)
Solids		
Total from Table B3-1 (cations)	2.05E+05	+8,920
Total from Table B3-2 (anions)	5.12 E+05	- 8,940
Water percent	2.79 E+05	n/a
Total:	9.96 E+05	-20
Drainable Liquids		
Total from Table B3-3 (cations)	1.71E+05	+7,430
Total from Table B3-4 (anions)	3.59E+05	- 6,212
Water percent	5.38E+05	n/a
Total:	1.07E+05	+1,218

B3.4 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

B3.4.1 Solid Data

A nested analysis of variance (ANOVA) model was fit to the solid segment data. Mean values, and 95 percent confidence intervals on the mean, were determined from the ANOVA. Four variance components were used in the calculations. The variance components represent concentration differences between risers, segments, laboratory samples, and analytical replicates. The model is:

$$Y_{ijk} = \mu + R_i + S_{ij} + L_{ijk} + A_{ijkm},$$

$$I=1,2,\ldots,a;\ j=1,2,\ldots,b_i;\ k=1,2,\ldots,c_{ij}\ ;m=1,2,\ldots,n_{ijk}$$

where:

Y_{ijkm} = concentration from the mth analytical result of the kth sample of the jth segment of the ith riser

μ = the mean

R_i	=	the effect of the i^{th} riser
S_{ij}	=	the effect of the j^{th} segment from the i^{th} riser
L_{ijk}	=	the effect of the k^{th} sample from the j^{th} segment of the i^{th} riser
A_{ijkm}	=	the analytical error
a	=	the number of risers
b_i	=	the number of segments from the i^{th} riser
c_{ij}	=	the number of samples from the j^{th} segment of the i^{th} riser
n_{ijk}	=	the number of analytical results from the ijk^{th} sample

The variables R_i, S_{ij}, and L_{ijk} are random effects. These variables, as well as A_{ijkm}, are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(R)$, $\sigma^2(S)$, $\sigma^2(L)$ and $\sigma^2(A)$, respectively.

The restricted maximum likelihood method (REML) was used to estimate the mean concentration and standard deviation of the mean for all analytes that had 50 percent or more of their reported values greater than the detection limit. The mean value and standard deviation of the mean were used to calculate the 95 percent confidence intervals. Table B3-6 gives the mean, degrees of freedom, and confidence interval for each constituent. The statistical results were obtained using the statistical analysis package S-PLUS[1] (Statistical Sciences 1993).

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used for nondetected results. For analytes with a majority of results below the detection limit, a simple average is all that is reported.

The lower and upper limits, LL (95 percent) and UL (95 percent), of a two-sided 95 percent confidence interval on the mean were calculated using the following equation:

$$\begin{aligned} LL(95\%) &= \hat{\mu} - t_{(df,\,0.025)} \times \hat{\sigma}(\hat{\mu}), \\ UL(95\%) &= \hat{\mu} + t_{(df,\,0.025)} \times \hat{\sigma}(\hat{\mu}). \end{aligned} \tag{3.4}$$

In this equation, $\hat{\mu}$ is the REML estimate of the mean concentration, $\hat{\sigma}(\hat{\mu})$ is the REML estimate of the standard deviation of the mean, and $t_{(df,\ 0.025)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom equals the number of risers

[1]S-PLUS is a registered trademark of Statistical Sciences, Seattle, Washington.

with data minus one. In cases where the lower limit (LL) of the confidence interval was negative, it is reported as zero.

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Data. (2 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum	ICP:A	1.65E+04	1	0.00E+00	6.35E+04	μg/g
^{241}Am[1]	GEA:F	<6.22E-01	n/a	n/a	n/a	μCi/g
Antimony[1]	ICP:A	<3.39E+01	n/a	n/a	n/a	μg/g
Arsenic[1]	ICP:A	<5.65E+01	n/a	n/a	n/a	μg/g
Barium[1]	ICP:A	<2.82E+01	n/a	n/a	n/a	μg/g
Beryllium[1]	ICP:A	<2.82E+00	n/a	n/a	n/a	μg/g
Bismuth[1]	ICP:A	1.19E+02	1	0.00E+00	6.33E+02	μg/g
Boron	ICP:A	1.15E+02	1	0.00E+00	2.73E+02	μg/g
Bromide[1]	IC:W	1.23E+03	1	0.00E+00	3.17E+03	μg/g
Cadmium[1]	ICP:A	8.42E+00	1	0.00E+00	3.90E+01	μg/g
Calcium[1]	ICP:A	1.21E+02	1	0.00E+00	3.66E+02	μg/g
Cerium[1]	ICP:A	<5.65E+01	n/a	n/a	n/a	μg/g
^{137}Cs	GEA:F	1.00E+02	1	0.00E+00	4.55E+02	μCi/g
Chloride	IC:W	2.63E+03	1	0.00E+00	7.34E+03	μg/g
Chromium	ICP:A	5.30E+03	1	0.00E+00	1.27E+04	μg/g
Cobalt[1]	ICP:A	<1.13E+01	n/a	n/a	n/a	μg/g
60Co[1]	GEA:F	<2.15E-02	n/a	n/a	n/a	μCi/g
Copper[1]	ICP:A	<5.65E+00	n/a	n/a	n/a	μg/g
^{154}Eu[1]	GEA:F	<7.24E-02	n/a	n/a	n/a	μCi/g
^{155}Eu[1]	GEA:F	<2.68E-01	n/a	n/a	n/a	μCi/g
Fluoride	IC:W	2.30E+03	1	0.00E+00	1.40E+04	μg/g
Total alpha[1]	Alpha:F	2.88E-02	1	0.00E+00	1.50E-01	μCi/g
Iron	ICP:A	1.65E+03	1	0.00E+00	1.49E+04	μg/g
Lanthanum[1]	ICP:A	<2.82E+01	n/a	n/a	n/a	μg/g
Lead[1]	ICP:A	<6.48E+01	n/a	n/a	n/a	μg/g
Lithium[1]	ICP:A	7.50E+01	1	0.00E+00	4.98E+02	μg/g
Magnesium[1]	ICP:A	<5.65E+01	n/a	n/a	n/a	μg/g
Manganese	ICP:A	6.18E+01	1	0.00E+00	4.27E+02	μg/g

Table B3-6. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Data. (2 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Molybdenum[1]	ICP:A	<2.92E+01	n/a	n/a	n/a	μg/g
Neodymium[1]	ICP:A	<5.65E+01	n/a	n/a	n/a	μg/g
Nickel[1]	ICP:A	2.90E+01	1	0.00E+00	1.21E+02	μg/g
Nitrate	IC:W	3.58E+05	1	0.00E+00	7.69E+05	μg/g
Nitrite	IC:W	2.36E+04	1	0.00E+00	8.08E+04	μg/g
Oxalate[1]	IC:W	4.51E+03	1	0.00E+00	1.72E+04	μg/g
Percent water	DSC/TGA	3.45E+01	1	8.13E+00	6.08E+01	%
Percent water	Percent solids	2.79E+01	1	7.90E+00	4.79E+01	%
Phosphate	IC:W	2.21E+04	1	0.00E+00	1.13E+05	μg/g
Phosphorus	ICP:A	6.69E+03	1	0.00E+00	3.51E+04	μg/g
Potassium	ICP:A	6.57E+02	1	0.00E+00	2.19E+03	μg/g
Samarium[1]	ICP:A	<5.65E+01	n/a	n/a	n/a	μg/g
Selenium[1]	ICP:A	<5.65E+01	n/a	n/a	n/a	μg/g
Silicon	ICP:A	4.59E+02	1	7.80E+01	8.40E+02	μg/g
Silver	ICP:A	1.67E+01	1	0.00E+00	4.92E+01	μg/g
Sodium	ICP:A	2.05E+05	1	6.02E+04	3.50E+05	μg/g
Strontium[1]	ICP:A	<5.68E+00	n/a	n/a	n/a	μg/g
Sulfate[1]	IC:W	7.79E+03	1	0.00E+00	2.62E+04	μg/g
Sulfur	ICP:A	2.44E+03	1	0.00E+00	9.11E+03	μg/g
Thallium[1]	ICP:A	<1.13E+02	n/a	n/a	n/a	μg/g
Titanium[1]	ICP:A	<5.65E+00	n/a	n/a	n/a	μg/g
TIC	TIC/TOC	6.59E+03	1	0.00E+00	2.34E+04	μg/g
TOC	TIC/TOC	2.09E+03	1	0.00E+00	6.91E+03	μg/g
Uranium[1]	ICP:A	<3.21E+02	n/a	n/a	n/a	μg/g
Vanadium[1]	ICP:A	<2.86E+01	n/a	n/a	n/a	μg/g
Zinc	ICP:A	2.36E+01	1	0.00E+00	1.13E+02	μg/g
Zirconium[1]	ICP:A	<6.66E+00	n/a	n/a	n/a	μg/g

Note:

[1] "less than" value was used in the calculations.

B3.4.2. Liquid Data.

The model fit to the liquid data was a nested ANOVA model. The model determined the mean value and 95 percent confidence interval for each constituent. Three variance components were used in the calculations. The variance components represent concentration differences between samples taken from different segments, from different sample numbers, and between analytical replicates. The model is:

$$Y_{ij} = \mu + S_i + L_{ij} + A_{ijk},$$

$$i=1,2,\ldots,a;\ j=1,2,\ldots,b_i;k=1,2,\ldots,n_{ij}$$

where

Y_{ij}	=	concentration from the j^{th} analytical result of the i^{th} riser
μ	=	the mean
S_i	=	the effect of the i^{th} segment
L_{ij}	=	the effect of the j^{th} sample of the i^{th} segment
A_{ijk}	=	the analytical error
a	=	the number of risers
b_i	=	the number of samples from the i^{th} segment
n_{ij}	=	the number of analytical results from the ij^{th} sample

The variables S_i and L_{ij} are random effects. These variables, along with A_{ijk}, are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(S)$, $\sigma^2(L)$, and $\sigma^2(A)$ respectively. The *df* associated with the standard deviation of the mean is the number of segments with data minus one.

The restricted maximum likelihood method (REML) was also used to estimate the mean concentration and standard deviation of the mean for all drainable liquid analytes that had 50 percent or more of their reported values greater than the detection limit. The mean value and standard deviation of the mean were used to calculate the 95 percent confidence intervals. Table B3-7 gives the mean, degrees of freedom, and confidence interval for each constituent. The statistical results were obtained using the statistical analysis package S-PLUS® (Statistical Science 1993).

Table B3-7. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (2 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum	ICP	3.85E+04	7	3.40E+04	4.30E+04	µg/mL
Antimony[1]	ICP	<3.61E+01	n/a	n/a	n/a	µg/mL
Arsenic[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Barium[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Beryllium[1]	ICP	<3.00E+00	n/a	n/a	n/a	µg/mL
Bismuth[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Boron	ICP	1.10E+02	7	9.75E+01	1.22E+02	µg/mL
Bromide[1]	IC	2.33E+03	7	9.08E+02	3.75E+03	µg/mL
Cadmium[1]	ICP	<3.00E+00	n/a	n/a	n/a	µg/mL
Calcium[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Cerium[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Chloride	IC	1.11E+04	7	5.75E+03	1.65E+04	µg/mL
Chromium	ICP	9.41E+03	7	8.47E+03	1.04E+04	µg/mL
Cobalt[1]	ICP	<1.20E+01	n/a	n/a	n/a	µg/mL
Copper[1]	ICP	<6.01E+00	n/a	n/a	n/a	µg/mL
Fluoride[1]	IC	<1.40E+02	n/a	n/a	n/a	µg/mL
Gross alpha[1]	Alpha Rad	<5.86E-03	n/a	n/a	n/a	µCi/mL
Iron[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Lanthanum[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Lead[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Lithium[1]	ICP	<9.24E+00	n/a	n/a	n/a	µg/mL
Magnesium[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Manganese[1]	ICP	<6.01E+00	n/a	n/a	n/a	µg/mL
Molybdenum	ICP	7.31E+01	7	6.50E+01	8.11E+01	µg/mL
Neodymium[1]	ICP	<6.01E+01	n/a	n/a	n/a	µg/mL
Nickel[1]	ICP	<1.20E+01	n/a	n/a	n/a	µg/mL
Nitrate	IC	2.40E+05	7	1.61E+05	3.20E+05	µg/mL
Nitrite	IC	1.09E+05	7	5.82E+04	1.61E+05	µg/mL
Oxalate[1]	IC	<1.64E+03	n/a	n/a	n/a	µg/mL
Percent water	DSC/TGA	5.38E+01	7	5.27E+01	5.49E+01	%
Phosphate[1]	IC	6.38E+03	7	4.25E+02	1.23E+04	µg/mL

Table B3-7. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (2 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Phosphorus	ICP	6.40E+02	7	5.70E+02	7.09E+02	μg/mL
Potassium	ICP	1.84E+03	7	1.67E+03	2.01E+03	μg/mL
Samarium[1]	ICP	<6.01E+01	n/a	n/a	n/a	μg/mL
Selenium[1]	ICP	<6.01E+01	n/a	n/a	n/a	μg/mL
Silicon	ICP	1.89E+02	7	9.38E+01	2.85E+02	μg/mL
Silver	ICP	1.81E+01	7	1.74E+01	1.88E+01	μg/mL
Sodium	ICP	2.44E+05	7	2.37E+05	2.51E+05	μg/mL
Specific gravity	SpG	1.43E+00	7	1.39E+00	1.47E+00	unitless
Strontium[1]	ICP	<6.01E+00	n/a	n/a	n/a	μg/mL
Sulfate[1]	IC	5.73E+03	7	2.74E+03	8.73E+03	μg/mL
Sulfur	ICP	1.14E+03	7	7.64E+02	1.51E+03	μg/mL
Thallium[1]	ICP	<1.20E+02	n/a	n/a	n/a	μg/mL
Titanium[1]	ICP	<6.01E+00	n/a	n/a	n/a	μg/mL
TIC	TIC/TOC	3.15E+03	7	1.96E+03	4.34E+03	μg/mL
TOC	Furnace Oxidation (TOC)	1.98E+03	5	1.59E+03	2.37E+03	μg/mL
TOC	TIC/TOC	1.21E+03	7	9.67E+02	1.45E+03	μg/mL
Uranium[1]	ICP	<3.00E+02	n/a	n/a	n/a	μg/mL
Vanadium[1]	ICP	<3.01E+01	n/a	n/a	n/a	μg/mL
Zinc[1]	ICP	8.44E+00	7	6.48E+00	1.04E+01	μg/mL
Zirconium[1]	ICP	<6.01E+00	n/a	n/a	n/a	μg/mL

Note:
[1]a "less than" value was used in the calculations

B4.0 APPENDIX B REFERENCES

Bates, J. M., and R. Shekarriz, 1996, *Sampling Plan for Tank 241-S-106 Retained Gas Sampler Deployment*, TWSMIT: FG-97-18, Pacific Northwest National Laboratory, Richland, Washington.

Bauer, R. E., and L. P. Jackson, 1997, *Flammable Gas Tank Safety Program: Data Requirements for Core Sample Analysis Developed through the Data Quality Objectives Process*, HNF-SD-WM-DQO-004, Rev. 2, DE&S Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Brown, T. M., S. J. Eberlein, J. W. Hunt, and L. J. Fergestrom, 1997, *Tank Characterization Technical Sampling Basis*, HNF-SD-WM-TA-164, Rev. 3, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Caprio, G. S., 1996, *Vapor and Gas Sampling of Single-Shell Tank 241-S-106 Using the Insitu Vapor Sampling System*, HNF-SD-WM-RPT-246, Rev. 0, SGN Eurisys Services Corp., Richland, Washington.

Buckley, L. L., 1997, *Tank 241-S-106 Push Mode Core Sampling and Analysis Plan*, WHC-SD-WM-TSAP-124, Rev. 0C, Lockheed Martin Hanford, Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Cash, R. J., 1996, *Application of "Flammable Gas Tank Safety Program Data Requirements for Core Sampling Analysis Developed through the Data Quality Objectives Process," Rev. 2*, (internal memorandum 79300-96-028 to S. J. Eberlein, July 12), Westinghouse Hanford Company, Richland, Washington.

Crawford, B. A., 1997, *Near Infrared Moisture Analysis in Saltcakes and Sludges*, (internal memorandum 8C520-097-801 to K. M. Hall, J. W. Hunt and J. G. Kristofzski, October 20), Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Esch, R. A., 1997, *Tank 241-S-106, Cores 183, 184 and 187 Analytical Results for the Final Report*, HNF-SD-WM-DP-242, Rev. 0A, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Evans, J. C., K. H. Pool, B. L. Thomas, K. B. Olson, J. S. Fruchter, and K. L. Silvers, 1997, *Headspace Vapor Characterization of Hanford Tank 241-S-106: Results from Samples Collected on 06/13/96*, PNNL-11260, Pacific Northwest National Laboratory, Richland, Washington.

Homi, C. S., 1995, *Vapor Sampling and Analysis Plan*, WHC-SD-WM-TP-335, Rev. 2A, Westinghouse Hanford Company, Richland, Washington.

Horton, J. E., 1975, *Analysis of Salt and Liquid Sample From 106-S Tank*, (letter to W. R. Christensen, July 23), Atlantic Richfield Hanford Company, Richland, Washington.

Mahoney, L. A., Z. I. Antoniak, and J. M. Bates, 1997, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-U-103, S-106, BY-101, and BY-109*, PNNL-11777, Pacific Northwest National Laboratory, Richland, Washington.

Markel, L. P., 1997, *222-S Laboratory Quality Assurance Plan*, HNF-SD-CP-QAPP-016, Rev. 2, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Meacham, J. E., D. L. Banning, M. R. Allen, and L. D. Muhlestein, 1997, *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue*, HNF-SD-WM-DQO-026, Rev. 0, DE&S Hanford, Inc.for Fluor Daniel Hanford, Inc., Richland, Washington.

Osborne, J. W., and L. L. Buckley, 1995, *Data Quality Objectives for Tank Hazardous Vapor Safety Screening*, WHC-SD-WM-DQO-002, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Pitkoff, C., 1991, *Sample 106-S Tank*, PM#91-139 to shift manager October 4, Westinghouse Hanford Company, Richland, Washington.

Pitkoff, C., 1992, *Sample Status Report for R 1131*, 651091-R, January 28, Westinghouse Hanford Company, Richland, Washington.

Rassat, S. D., 1997, *Gas Bubble Retension and Release Studies Test Plan, 325-BUB-FY97.TP*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

Schreiber, R. D., 1997, *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements*, HNF-SD-WM-RD-060, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Simpson, B. C., and D. J. McCain, 1997, *Historical Model Evaluation Data Requirements*, WHC-SD-WM-DQO-018, Rev. 2, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Statistical Science, 1993, *S-PLUS Reference Manual, Version 3.2*, Statistical Sciences, a division of MathSoft, Inc., Seattle, Washington.

APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

Appendix C documents the results of the analyses and statistical and numerical manipulations required by the DQOs applicable to tank 241-S-106. The analyses required for tank 241-S-106 are reported as follows:

- **Section C1.0**: Statistical analysis and numerical manipulations supporting the safety screening DQO (Dukelow et al. 1995)
- **Section C2.0**: Gateway analysis for the historical model DQO (Simpson and McCain 1995)
- **Section C3.0**: Appendix C references.

C1.0 STATISTICS FOR THE SAFETY SCREENING DATA QUALITY OBJECTIVE

The safety screening DQO (Dukelow et al. 1995) defines decision limits in terms of one-sided 95 percent confidence intervals. The safety screening DQO limits are 34.9 μCi/g for gross alpha and 480 J/g for DSC.

Confidence intervals were calculated for the mean values from each laboratory sample. The data used in the computations was from the data package of the 1997 core sampling event. Table C1-1 has the total alpha activity results; Table C1-2 has the DSC results.

The upper limit (UL) of a one-sided 95 percent confidence interval on the mean is

$$\hat{\mu} + t_{(df,0.05)}\, \hat{\sigma}_{\hat{\mu}}.$$

In this equation, $\hat{\mu}$ is the arithmetic mean of the data, $\hat{\sigma}_{\hat{\mu}}$ is the estimate of the standard deviation of the mean, and $t_{(df,0.05)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom equals the number of samples minus one.

For sample numbers with at least one value above the detection limit, the UL of a 95 percent confidence interval is given in Table C1-1. Each confidence interval can be used to make the following statement. If the upper limit is less than 32 μCi/g (61.5 μCi/mL for drainable liquid), reject the null hypothesis that the total alpha activity is greater than or equal to 32 μCi/g (61.5 μCi/mL for drainable liquid) at the 0.05 level of significance.

Twenty-five of the 38 total alpha activity results were above the detection limit. The UL closest to the threshold was 1.57E-01μCi/g, for core 184, segment 2, well below the limit of 34.9 μCi/g.

Table C1-1. 95 Percent Upper Confidence Limits for Total Alpha Activity.

Lab Sample ID	Description	μ	df	UL	Units
S97T000304F	Core 183, segment 4, lower half	9.50E-03	1	1.52E-02	μCi/g
S97T000305F	Core 183, segment 5, lower half	1.78E-02	1	4.02E-02	μCi/g
S97T000306F	Core 183, segment 7, lower half	1.11E-02	1	1.85E-02	μCi/g
S97T000330F	Core 183, segment 8, lower half	3.45E-02	1	4.88E-02	μCi/g
S97T000332F	Core 183, segment 9, lower half	3.59E-02	1	5.55E-02	μCi/g
S97T000341	Core 184, segment 1, subsample	5.34E-04	1	1.25E-03	μCi/mL
S97T000346F	Core 184, segment 2, lower half	1.10E-01	1	1.57E-01	μCi/g
S97T000351	Core 184, segment 2, subsample	2.58E-03	1	2.77E-03	μCi/mL
S97T000362F	Core 184, segment 4, lower half	1.73E-02	1	2.05E-02	μCi/g
S97T000416F	Core 184, segment 6, lower half	3.12E-02	1	7.57E-02	μCi/g
S97T000421	Core 184, segment 6, subsample	2.06E-03	1	5.57E-03	μCi/mL
S97T000428F[1]	Core 184, segment 6R, lower half	8.52E-03	1	1.68E-02	μCi/g
S97T000441F[1]	Core 184, segment 6R, lower half	1.31E-02	1	2.70E-02	μCi/g
S97T000445[1]	Core 184, segment 6R, subsample	5.90E-03	1	1.16E-02	μCi/mL

Note:

[1]A "less than" value was used in the calculations.

Thirteen of the 60 DSC results had no exothermic reaction. For those samples with at least one exothermic value, a 95 percent upper confidence limit is given in Table C1-2. All results are expressed on a dry weight basis. Each confidence interval can be used to make the following statement. If the upper limit is less than 480 J/g, reject the null hypothesis that DSC is greater than or equal to 480 J/g at the 0.05 level of significance. The maximum upper limit to a 95 percent confidence interval on the mean for DSC was 1.47E+03 J/g for core 183, segment 3. This is above the threshold limit of 480 J/g.

Table C1-2. 95 Percent Upper Confidence Limits for Differential Scanning Calorimetry.

Lab Sample ID	Description	μ	df	UL	Units (dry wt)
S97T000276[1,2]	**Core 183, segment 1**	**4.30E+02**	**5**	**9.66E+02**	**J/g**
S97T000283[2]	**Core 183, segment 3**	**1.15E+03**	**1**	**1.47E+03**	**J/g**
S97T000284[3]	*Core 183, segment 4*	*1.39E+02*	*1*	*7.90E+02*	*J/g*
S97T000285[2]	**Core 183, segment 5**	**5.64E+02**	**3**	**8.73E+02**	**J/g**
S97T000286[2]	**Core 183, segment 7**	**5.65E+02**	**3**	**9.11E+02**	**J/g**
S97T000298[1,3]	*Core 183, segment 4, lower half*	*3.22E+02*	*5*	*8.31E+02*	*J/g*
S97T000299[1,3]	*Core 183, segment 5, lower half*	*1.63E+02*	*1*	*1.19E+03*	*J/g*
S97T000300	Core 183, segment 7, lower half	1.88E+02	3	4.67E+02	J/g
S97T000316	Core 183, segment 8, upper half	2.60E+02	1	4.56E+02	J/g
S97T000324	Core 183, segment 8, lower half	2.24E+02	1	4.21E+02	J/g
S97T000325[3]	*Core 183, segment 9, upper half*	*1.18E+02*	*1*	*6.67E+02*	*J/g*
S97T000326	Core 183, segment 9, lower half	1.96E+02	1	2.39E+02	J/g
S97T000340[3]	*Core 184, segment 1*	*2.53E+02*	*1*	*8.71E+02*	*J/g*
S97T000344	Core 184, segment 2, lower half	2.68E+01	1	3.20E+01	J/g
S97T000350[3]	*Core 184, segment 2*	*2.94E+02*	*1*	*1.24E+03*	*J/g*
S97T000354	Core 184, segment 4, upper half	2.79E+01	1	9.42E+01	J/g
S97T000360	Core 184, segment 4, lower half	1.35E+01	1	4.86E+01	J/g
S97T000408	Core 184, segment 6, upper half	2.34E+02	1	2.59E+02	J/g
S97T000414[3]	*Core 184, segment 6, lower half*	*3.15E+02*	*1*	*1.19E+03*	*J/g*

Notes:

[1]The value of zero was used for an exothermic result.
[2]Bold text means the mean and upper limit exceed the notification limit.
[3]Text in italics means the upper limit exceeds notification limit.

C2.0 GATEWAY ANALYSIS FOR HISTORICAL MODEL DATA QUALITY OBJECTIVE

The primary objective of the historical model evaluation DQO (Simpson and McCain 1997) is to acquire adequate information through selective tank sampling to quantify the errors associated with predicting tank waste composition based on waste transaction history and waste type compositions. The DQO identifies key waste components and their characteristic concentrations for certain waste types.

The first step in the evaluation is to compare the analytical results with DQO defined concentration levels for a selected number of analytes. This ensures that the predicted waste type may be in the tank at the predicted location. If the analytical results are $\geq$10 percent of the DQO levels (ratio of 0.1 or more), the waste type and layer identification are considered acceptable for further investigation, and additional analyses are requested on selected segments and composite samples.

Although tank 241-S-106 in not listed as a priority tank in Simpson and McCain (1997), it is an acceptable alternate for tank 241-S-110 (Simpson and McCain 1997). Except for a heel of CWR1 sludge, Agnew et al. (1997) predicts that tank solids are SMMS1. Sample results showed that the top four segments of core 83 and core 84 were primarily drainable liquid. These segments were not included in the gateway analysis. Table C2-1 compares the expected and measured concentrations for the S1 saltcake in core 83 and core 84 solids samples.

Table 2-1 shows that most segments and all analytes passed the gateway analysis. The fingerprint analytes accounted for <85 percent of the waste mass for segments 183:5L and 183:9L. This indicates that, except for these segments, the waste is consistent with the S1 saltcake waste type. Segment 183:9L (near the bottom of the tank) may be a combination of S1 saltcake and some other waste type. It does not appear to be CWR1 sludge, as expected. Based on process history and results for surrounding segments, segment 183:5L is expected to be an S1 saltcake. Consequently, additional analyses were performed on this segment even though it did not pass the gateway analysis.

Table C2-1. Tank 241-S-106 Historical Model Evaluation for S1 Saltcake.[1]

Core: Segment	Fingerprint Analytes (Percent by Weight)								Analytes >10% of Expected ?
	Na	Al	NO_3	SO_4	Cr	CO_3	H_2O	Total	
183:4 Lower half	19.5	1.88	22.5	1.02	0.65	0.67	51.4	97.1	Yes
183:5 Lower half	19.4	2.02	17.5	1.07	0.59	0.79	32.0	**72.7**[2]	Yes
183:7 Lower half	20.9	1.54	35.8	0.3	0.41	0.56	29.1	88.1	Yes
183:8 Upper half	18.8	1.97	32.8	0.99	0.87	2.04	29.4	85.2	Yes
183:8 Lower half	19.0	1.64	44.1	0.74	0.61	1.41	28.3	94.7	Yes
183:9 Upper half	18.9	1.95	39.8	0.60	0.50	1.35	24.4	86.4	Yes
183:9 Lower half	16.7	3.74	17.3	0.56	0.58	2.18	31.6	**73.9**[2]	Yes
184:2 Lower half	20.8	0.98	63.7	0.32	0.56	0.84	33.1	120.0	Yes
184:4 Upper half	22.5	1.49	20.5	0.26	0.74	1.75	40.1	85.9	Yes
184:4 Lower half	22.1	1.27	40.5	0.73	0.43	0.62	34.3	99.5	Yes
184:6 Upper half	20.6	1.14	23.5	1.28	0.57	1.13	42.8	90.1	Yes
184:6 Lower half	21.8	0.775	42.0	0.38	0.38	0.84	35.3	100.0	Yes
184:6R Lower half	21.8	1.06	43.6	0.38	0.31	0.4	32.5	99.7	Yes
184:6RA Lower half	22.3	2.14	39.1	0.51	0.33	0.58	30.3	94.8	Yes
Expected for S1 saltcake[2]	19.54	3.10	27.43	1.07	0.592	1.70	32.1	85.0	

Notes:

[1]Simpson and McCain (1997)

[2]Less than 85 percent of total mass. Segment fails the gateway analysis.

The final test was to compare analytical results for composite samples and selected segments with HDW model estimates (Agnew et al. 1997) for SMMS1 analyte concentrations in tank 241-S-106. Because of the limited amount of solids in segments 1 to 4, composites were not prepared. Consequently, analytical comparisons with HDW estimates were limited to results for segment 183:5 lower half and 184:6 upper half. Results of the analyses are shown in Table C2-2.

Table C2-2. Comparison of Selected Segments and HDW Estimates for 241-S-106 Saltcake.

Analytes		Core 183: 5 Lower	Core 184: 6 Upper	HDW Estimates (SMM for Tank 241-S-106)
Na	(μg/g)	194,000	206,000	211,000
Al	(μg/g)	20,200	11,400	33,800
NO_3	(μg/g)	175,000	235,000	185,000
CO_3	(μg/g)	7,900	11,300	10,500
SO_4	(μg/g)	10,700	12,800	10,700
Cr	(μg/g)	5,900	5,700	6,500
H_2O	(%)	32.0%	42.8%	31.0%
U total	(μg/g)	84.4	375	1,360
^{90}Sr	(μCi/g)	1.98	27.9	67.6
Total beta	(μCi/g)	143	126	~ 294 ^{90}Sr + ^{137}Cs
Total alpha	(μCi/g)	0.0178	0.0312	~ 0.121 ^{239}Pu + ^{241}Am
TOC	(μgC/g)	1,580	2,250	3,420
Bulk density	(g/mL)	1.72	1.58	1.66

Table C2-2 shows that the concentration of all the indicator analyte values for the selected segments were >10% of the historical model estimates for the SMM saltcake in this tank.

In summary, all segments analyzed agree with S1 saltcake estimates and historical model predictions. The upper four segments of tank 241-S-106 are mostly drainable liquids with few solids. Segments 4 to 9 are mostly solids, probably precipitated from the SMMS1 solution. The bottom of the tank (segment 9L) appears to be a saltcake, but it does not exhibit characteristics of SMMS1 or CWR1.

C3.0 APPENDIX C REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, New Mexico.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Simpson, B. C., and D. J. McCain, 1996, *Historical Model Evaluation Data Requirements*, WHC-SD-WM-DQO-118, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-S-106

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-S-106

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-S-106 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Available waste (chemical) information for tank 241-S-106 includes the following:

- Analytical data from February/March 1997 push core samples
- Tank waste photographs
- Analytical data from other S and U farm tanks with a similar saltcake waste type were used as a basis for comparing analytical results for tank 241-S-106
- The Hanford Defined Waste (HDW) model document (Agnew et al. 1997b) provides tank content estimates in terms of component concentrations and inventories.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The tank 241-S-106 chemical and radionuclide inventories predicted from the HDW model estimates (Agnew et al. 1997b), and previous best basis estimates are shown in Tables D2-1 and D2-2. The chemical species are reported without charge designation per the best-basis inventory convention. These inventory calculations do not include 15 kL (4 kgal) of supernatant predicted by Hanlon (1998). The HDW model and previous best basis inventory estimates are based on the same volume 1,798 kL (475 kgal), and densities of 1.66 g/mL and 1.63 g/mL respectively.

Table D2-1. Comparison of Inventory Estimates for Nonradioactive Components in Tank 241-S-106. (2 sheets)

Analyte	HDW[1] Inventory Estimate (kg)	Previous Best Basis Estimate[2] (kg)
Al	1.31E+05	62,900
Bi	232	232
Ca	2,620	829
Cl	15,400	11,000
Cr	18,200	15,300
F	1,000	17,100
Fe	1,990	4,800
Hg	101	101
K	4,220	3,130
La	0.00769	0.00769
Mn	283	2,160
Na	6.12E+05	5.18E+05
Ni	593	450
NO_2	2.31E+05	1.64E+05
NO_3	5.22E+05	4.72E+05
OH	4.52E+05	2.22E+05
oxalate	0.00638	NA
Pb	3,200	532
PO_4	9,150	93,300
Si	3,470	5,710
SO_4	30,100	38,000
TIC as CO_3	30,400	30,400
TOC	9,570	24,900

Table D2-1. Comparison of Inventory Estimates for Nonradioactive Components in Tank 241-S-106. (2 sheets)

Analyte	HDW[1] Inventory Estimate (kg)	Previous Best Basis Estimate[2] (kg)
U_{TOTAL}	9,040	4,160
Zr	20.4	142
H_2O (wt%)	30.6	n/r
density (kg/L)	1.66	n/r

Notes:

HDW = Hanford defined waste

[1]Agnew et al. (1997b).
[2]Effective May 31, 1997, this inventory was generated before core samples were taken. It assumed an SMMS1 layer and an R/CWR sludge layer.

Table D2-2. Comparison of Inventory Estimates for Selected Radioactive Components in Tank 241-S-106. (2 sheets)

Analyte	HDW[1] Inventory Estimate (Ci)	Previous Best Basis Estimate[2] (kg)
^{14}C	58.4	58.4
^{90}Sr	1.90E+05	3.22E+05
^{99}Tc	418	418
^{129}I	0.805	0.805
^{137}Cs	5.08E+05	4.58E+05
^{154}Eu	978	978
^{155}Eu	306	306

Table D2-2. Comparison of Inventory Estimates for Selected Radioactive Components in Tank 241-S-106. (2 sheets)

Analyte	HDW[1] Inventory Estimate (Ci)	Previous Best Basis Estimate[2] (kg)
^{237}Np	1.64	1.64
$^{239/240}Pu$	306	306
^{241}Pu	300	300
^{241}Am	98.0	980
^{60}Co	59.9	59.9

Notes:

[1]Agnew et al. (1997b), decayed to January 1, 1994.

[2]Effective May 31, 1997, this inventory was generated before core samples were taken. It assumed an SMMS1 layer and an R/CWR sludge layer.

D3.0 COMPONENT INVENTORY EVALUATION

D3.1 WASTE HISTORY

Tank 241-S-106 is the third tank of a three tank cascade including tanks 241-S-104 and 241-S-105. Reduction and oxidation (REDOX) high-level waste (R) and REDOX cladding waste (CWR) were initially sent to the cascade in the first quarter of 1953. Tank 241-S-106 started receiving waste via the cascade in the second quarter of 1953 until the third quarter of 1953. The tank waste was classified as R waste in the Waste Status and Transaction Record Summary (WSTRS) (Agnew et al. 1997a) at the end of 1953. Supernate was transferred from the tank in 1955.

Agnew et al. (1997a) reports eight more transfers into tank 241-S-106 between the first quarter of 1954 and 1980. These transfers included waste from tanks 241-S-102, 241-S-103, and 241-S-107 along with two water additions.

Tank 241-S-106 is currently classified as sound and partially isolated and is not on any of the watch lists.

D3.2 CONTRIBUTING WASTE TYPES

The HDW model (Agnew et al. 1997b) predicts that the tank contains a total of 1,798 kL (475 kgal) of solid waste. The waste is predicted to consist of 121 kL (32 kgal) of REDOX cladding waste (CWR) and 1,678 kL (443 kgal) of 242-S Evaporator saltcake (SMMS1) generated from 1973 until 1976, predicted from the Supernatant Mixing Model (SMM). Agnew et al. (1997b) indicates that the expected sludge in the bottom of the tank settled from waste that cascaded from tank 241-S-104 to 241-S-105 to 241-S-106. During the time the cascade was active, tank 241-S-106 was receiving both direct REDOX high-level waste (R) and CWR waste.

The Sort on Radioactive Waste Type (SORWT) model (Hill et al. 1995) lists R waste and Evaporator Bottoms (EB) as the primary and secondary waste types respectively. Evaporator Bottoms waste is the generic SORWT definition for saltcake that is roughly equivalent to the SMM waste types.

Hanlon (1998) reports 1,813 kL (479 kgal) of waste that consists of 106 kL (28 kgal) of sludge, 1,692 kL (447 kgal) of saltcake, 15 kL (4 kgal) of supernatant, and 704 kL (186 kgal) of drainable interstitial liquid.

D3.3 MAJOR ANALYTES OF CONTRIBUTING WASTE TYPES

The R layer should contain large quantities of aluminum, chromium, iron, sodium, and nitrite. This waste type should also contain appreciable quantities of ^{90}Sr, and ^{137}Cs. REDOX high-level waste entered the tank with CWR waste from the 241-S-104 cascade through 241-S-105 to 241-S-106. REDOX high-level waste is predicted by Hill et al. (1995), but Agnew et al. (1997b) predicts only CWR waste is in the tank.

REDOX cladding waste from 1952 to 1960 (CWR1) has high concentrations of uranium, sodium, aluminum, silica, nitrate, nitrite, and hydroxide; moderate quantities of calcium, carbonate and iron; and low concentrations of strontium and cesium. Aluminum and uranium concentrations are predicted to be significantly higher than that found in R waste generated from 1952 to 1957 (R1 waste).

Core samples showed that the waste recovered was all saltcake. The lower half of segment 9, core 183 did not appear to be an SMMS1 saltcake, but it also did not exhibit any of the expected characteristics of R or CWR waste (see Section C.2). Because tank 241-S-106 is the third tank in a three tank cascade, it is feasible that very little sludge was transferred to tank 241-S-106 and all or most of the CWR1 waste was removed in supernatant transfers (see Appendix A). Consequently, it is assumed that no sludge remains in tank 241-S-106 and all the waste is saltcake.

The SMMS1 waste composition should contain large quantities of sodium and nitrate, nitrite, sulfate, phosphate, carbonate, hydroxide and aluminum; and moderate quantities of calcium, iron, chromium, uranium, potassium, and total organic carbon (TOC). The plutonium concentration for the SMMS1 waste type should be much lower than CWR1 waste. The radioactivity for the evaporator concentrated waste types should be higher than for CWR1 waste but lower than for REDOX high-level waste.

D3.4 EVALUATION OF TANK WASTE VOLUME

The tank 241-S-106 surface level is monitored with an ENRAF gauge. As of March 23, 1997, surveillance data indicated a waste height of 458.9 cm (180.66 in.), which corresponds to 1,803 kL (476 kgal) of total waste in the tank. This essentially agrees with the total waste volume of 1,813 kL (479 kgal) reported by Hanlon (1998) and the 1,798 kL (475 kgal) predicted by Agnew et al. (1997b). However, sample results appear to be inconsistent with Hanlon (1998) estimates for supernatant (15.1 kL [4 kgal]) and drainable interstitial liquid (704 kL [186 kgal]) in the tank.

A combination of sample results and tank waste photographs were used to estimate the volume of liquid in this tank. Tank photos show a liquid pool with an estimated average radius of 457 cm (15 ft) located near the center of tank 241-S-106. Samples from risers 8 and 7, located within the liquid pool, contained mostly drainable liquid for the top seven and three segments respectively. Segments 8 to 10 from riser 8 were solids with little or no liquid. Segments 4 to 6 from riser 7 were also solids. The waste was too hard to penetrate below segment six in riser 7 and in riser 14 (located outside the liquid pool, near the northeast side of the tank). Assuming the liquid pool is in the shape of a hemisphere, the volume of free standing liquid or supernatant in the tank would be 201 kL (53 kgal). This volume was used for the engineering evaluation.

The solids volume (1,612 kL [426 kgal]) used in the engineering evaluation was derived by subtracting the supernatant volume 201 kL (53 kgal) from a total waste volume of 1,813 kL (479 kgal). Laboratory extrusions indicated that little or no drainable interstitial liquid was present in the solids.

Based on saltwell pumping test results, the average drainable porosity for saltcake is 50 percent (Brown 1996). Based on this observation, tank 241-S-106 would be expected to contain 806 kL (212 kgal) of drainable interstitial liquid. However, 378 kL (99.8 kgal) of interstitial liquid was pumped from tank 241-S-106 between 1978 and 1980 decreasing the solids volume in the tank by 322 kL (85 kgal) (Brown 1996). The tank was saltwell pumped twice in 1993 and 1994, removing an additional 492 kL (130 kgal). Although it is possible that some interstitial drainable liquid remains in the solids, there was no indication of this in the extruded samples.

D3.5 ASSUMPTIONS USED

An engineering evaluation based on tank 241-S-106 sample results was conducted to predict tank contents and compare results with the previous best basis and HDW model results. The engineering evaluation assumes the following:

- The total tank volume listed in Hanlon (1998) 1,813 kL (479 kgal) is used. All three sources of volume estimates are within 1 percent of each other.

- The liquid and solids volumes used to calculate analyte inventories are specified in Section D3.4. The solids analytical mean density is 1.74 g/mL and specific gravity of the liquids is 1.43.

- Only the SMMS1 waste stream contributed to solids formation. No measurable R/CWR waste is present in the tank.

- All radionuclide data are corrected to January 1, 1994.

D3.6 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

Table D3-1 summarizes the engineering evaluation approach.

Table D3-1. Engineering Evaluation Approach Used On 241-S-106.

Type of Waste	How Calculated	Check Method
Supernatant	Multiplied supernatant sample-based concentrations (Table B3-7) by 201 kL (53 kgal).	Compare with predicted SMMS1 liquid waste type (Agnew 1997b).
Saltcake	Multiplied tank 241-S-106 sample-based solids concentrations (Table B3-6) by an average density of 1.74 g/mL and solids volume of 1,612 kL (426 kgal).	Compared sample based concentrations for other tanks containing SMMS1 waste (Table D3-2).

3.6.1 Solids

The SMMS1 component concentrations for four tanks (241-S-101, 241-S-102, 241-U-106, and 241-U-109 [Kruger et al. 1996, Eggers et al. 1996, Brown et al. 1997, and Baldwin and Stephens 1996]) known to contain the same SMMS1 saltcake waste type as tank 241-S-106 were averaged to provide a generalized composition for SMMS1 saltcake. These concentrations are compared with tank 241-S-106 solids sample concentrations in Table D3-2. In addition, the saltcake composition predicted by Agnew et al. (1997b) for tank 241-S-106 is shown in Table D3-2.

As indicated in Table D3-2, in general, good agreement was found between the predicted SMMS1 concentrations and analytical results for tank 241-S-106. The concentrations of major waste components (for example, Na, Al, NO_3, NO_2, and SO_4) for the four tanks containing SMMS1 saltcake vary between tanks by no more than a factor of three. An exception is phosphate, which exhibits exceptionally high concentrations for tank 241-S-102 waste and, thus, skews the average concentration high for phosphate. The variation between several minor components for the four tanks is also high.

Table D3-2. SMMS1 Saltcake Solids Concentrations. (2 sheets)

Analyte	241-S-101 Segments 2L-4U[1] μg/g	241-S-102 Segments 7L-10U[2] μg/g	241-U-106 Segments 2U-4L[3] μg/g	241-U-109 Segments 5U-8L[4] μg/g	Average[5] μg/g	HDW Model SMM for 241-S-106[6] μg/g	241-S-106 Solids Analytical Mean[7] μg/g
Al	18,000	15,085	13,620	13,625	15,100	33,800	16,500
Ag	12	17	16	n/r	15	n/r	16.7
B	110	75	80	n/r	88	n/r	115
Bi	71	76	<DL	<DL	73.5	82.7	119
Ca	273	237	336	<DL	282	727	121
Cl	4,500	4,099	2,926	n/r	3,842	5,490	2,630
Cr	10,000	4,359	3,170	4,233	5,440	6,500	5,300
F	500	13,596	4,669	n/r	6,255	359	2,300
Fe	508	1,298	3,096	<DL	1,630	311	1,650
K	1,109	898	1,309	n/r	1,110	1,500	657
La	<DL	37	43	n/r	40	0.00275	<28.2
Mn	266	597	1,189	<DL	684	101	61.8
Na	1.50E+05	1.90E+05	1.71E+05	2.18E+05	1.82E+05	2.11E+05	2.05E+05
Ni	114	49	304	<DL	155	209	29.0
NO_2	91,000	40,100	56,000	42,900	57,500	80,600	23,600
NO_3	1.10E+05	99,200	1.47E+05	2.97E+05	1.63E+05	1.85E+05	3.58E+05
Pb	91	137	348	n/r	192	88.3	<64.8
PO_4	9,500	114,500	5,888	5,970	34,000	3,270	22,100
P	2,290	33,900	1,949	<DL	12,700	n/r	6,690
S	5,940	2,683	3,878	n/r	4,170	n/r	2,440
Si	5,269	517	176	<DL	1,990	1,210	459
SO_4	20,700	12,500	10,774	11,100	13,800	10,700	7,790

Table D3-2. SMMS1 Saltcake Solids Concentrations. (2 sheets)

Analyte	241-S-101 Segments 2L-4U[1] µg/g	241-S-102 Segments 7L-10U[2] µg/g	241-U-106 Segments 2U-4L[3] µg/g	241-U-109 Segments 5U-8L[4] µg/g	Average[5] µg/g	HDW Model SMM for 241-S-106[6] µg/g	241-S-106 Solids Analytical Mean[7] µg/g
Sr	7	<DL	<DL	n/r	7	0	<5.68
TOC	1,900	5,340	24,626	3,920	8,950	9,570	2,090
U	560	1,403	781	<DL	914	1,360	<321
Zn	30	32	54	<DL	39	n/r	23.6
Zr	14	39	88	n/r	47	7.3	<6.66
oxalate	15,400	15,700	9,880	n/r	13,700	0.00228	4,510
density g/mL	1.58	1.69	1.57	1.67	1.63	1.66	1.74
Radionuclides[8] (µCi/g)							
^{90}Sr	252	23	77	9	90	67.6	14.9
^{137}Cs	175	121	175	142	153	181	100

Notes:

<DL = Less then the detectable limit
SMM = Supernatant Mixing Model

[1] Kruger et al. (1996)
[2] Eggers et al. (1996)
[3] Brown et al. (1997)
[4] Baldwin and Stephens (1996)
[5] Average of tank 241-S-101, 241-S-102, 241-U-106, and 241-U-109 concentrations
[6] Agnew et al. (1997b)
[7] Appendix B, Table B3-6
[8] Radionuclides are reported as of the date of sample analysis.

For most analytes, the concentrations for the four SMMS1 saltcake tanks compare within a factor of approximately two with the predicted SMMS1 composition from the HDW model. However, significant differences occur for several analytes, including: F, Fe, PO_4, Mn, Si, and oxalate. The concentrations of these components for the four saltcake tanks are consistently higher than the HDW model estimates.

For all analytes measured, tank 241-S-106 analytical values were determined to be the most reliable and are used for solids inventory calculations.

D3.6.2 Supernatant

Average supernatant concentrations (Appendix B) and S1 saltcake liquid predictions (Agnew 1997b) are compared in Table D3-3. For all analytes measured, tank 241-S-106 analytical values were determined to be the most reliable, and were used for supernatant inventory calculations.

D3.7 ESTIMATED COMPONENT INVENTORIES

The sampling based inventory, hereafter referred to as the engineering assessment, for tank 241-S-106 was calculated by adding together solid and drainable liquid inventories calculated using the approach described in Table D3-1. Solid, liquid and total tank inventories determined by this evaluation are shown in Table D3-4. Table D3-4 also shows HDW model inventory estimates for tank 241-S-106 (Agnew 1997b).

Except for fluoride, phosphate, ^{137}Cs and ^{90}Sr, values for the engineering assessment and HDW model inventory vary by a factor of two or lower. Some of the variability can be attributed to the sludge layer predicted by Agnew et al (1997b), but not observed in sample results. A comparison of inventory calculations specific analytes follows.

Chromium. The chromium content of the solids in tank 241-S-106, as determined by the sample-based inventory, is 14,900 kg. This value is lower than the value of 18,200 kg of chromium predicted by the HDW Model.

Sodium. The sodium content of the solids in tank 241-S-106 as determined by the sample-based (5.75E+05 kg) is in good agreement with the value predicted by the HDW Model (6.12 E+05 kg).

Nitrite and Nitrate. Tank 241-S-106 engineering assessment based inventories are higher in nitrate and lower in nitrite than predicted by the HDW model.

Table D3-3. S1 Saltcake Supernatant Concentrations. (2 sheets)

Analyte	HDW Model S1 Sltck Supernatant [1] $\mu g/g$	241-S-106 Supernatant Analytical Mean/SpG[2] $\mu g/g$
Al	33,300	26,900
Ag	n/r	12.7
B	n/r	76.9
Bi	252	<42.0
Ca	158	<42.0
Cl	5,090	7,760
Cr	2,840	6,580
F	1,070	97.9
Fe	24.1	<21.0
K	2,210	1,290
La	1.32	<21.0
Mn	37.9	<4.2
Na	2.07E+05	1.71E+05
Ni	43.6	<8.39
NO_2	77,700	76,200
NO_3	99,700	1.68E+05
Pb	191	<42.0
PO_4	9,310	4,460
P	NR	448
S	NR	797
Si	473	132
SO_4	22,300	4,010
Sr	0	<4.20
TOC	10,700	846
U	n/r	<210
Zn	n/r	<5.90
Zr	15.3	<4.20
oxalate	1.09	<1,150
Specific Gravity	1.63	1.43

Table D3-3. S1 Saltcake Supernatant Concentrations. (2 sheets)

Analyte	HDW Model S1 Sltck Supernatant [1] $\mu g/g$	241-S-106 Supernatant Analytical Mean/SpG[2] $\mu g/g$
Radionuclides[3] ($\mu Ci/g$)		
^{90}Sr	20.6	n/r
^{137}Cs	246	n/r

Notes:

[1] Agnew et al. (1997b)
[2] Appendix B, Table B3-7
[3] Radionuclides are reported as of the date of sample analysis.

Table D3-4. Comparison of Inventory Estimates for Tank 241-S-106. (2 sheets)

Component	Sample Based Solids Inventory[1] (kg)	Sample Based Liquids Inventory[1] (kg)	Sample Based Total Inventory[1] (kg)	HDW Model Estimates[2] (kg)
Al	46,300	7,740	54,000	131,000
Bi	334	<12.1	334	232
Ca	339	<12.1	339	2,620
Cl	7,380	2,230	9,610	15,400
TIC as CO_3	92,400	3,170	95,600	30,400
Cr	14,900	1,890	16,800	18,200
F	6,450	<28.1	6,450	1,000
Fe	4,630	<6.05	4,630	1,990
K	1,840	370	2,210	4,220
La	<79.1	<6.05	<85.2	0.00769
Mn	173	<1.21	173	283
Na	5.75E+05	49,000	6.24E+05	6.12E+05
Ni	81.3	<2.41	81.3	593
NO_2	66,200	21,900	88,100	2.31E+05
NO_3	1.00E+06	48,200	1.05E+06	5.22E+05
Pb	<182	<12.1	<194	3,200

Table D3-4. Comparison of Inventory Estimates for Tank 241-S-106. (2 sheets)

Component	Sample Based Solids Inventory[1] (kg)	Sample Based Liquids Inventory[1] (kg)	Sample Based Total Inventory[1] (kg)	HDW Model Estimates[2] (kg)
PO_4	62,000	1,280	63,300	9,150
Si	1,290	38.0	1,330	3,470
SO_4	21,900	1,150	23,000	30,100
Sr	<15.9	<1.2	<17.1	0
TOC	5,860	243	6,110	9,570
U	<900	<60.3	<961	9,040
Zr	<18.7	<1.21	<19.9	20.4
^{137}Cs (Ci)[3]	2.81E+05	NR	2.81E+05	5.08E+05
^{90}Sr (Ci)[3]	41,800	NR	41,800	1.90E+05

Notes:

[1]Based on average sample concentrations (Tables B3-4 and B3-5)
[2]Agnew et al. (1997b)
[3]Radionuclides decayed to January 1, 1994.

Sulfate. The sulfate inventory for tank 241-S-106 was lower for the engineering assessment than for the HDW model, but within a factor of two.

Manganese. The HDW model and engineering assessment predict low Mn inventories for tank 241-S-106.

Phosphate. There is a large difference between the sample-based inventory (63,300 kg) and the HDW model estimate (9,150 kg). Lower phosphate values in the HDW model have been noted consistently for SMMS1 and REDOX type waste and are attributed to solubility assumptions in the model. Sample-based inventories are similar to SMMS1 sample results for other tanks (Table D3-2).

Total Organic Carbon. The TOC value for the HDW model inventory was about two times higher than the engineering-based inventory. Although the average TOC concentration for selected SMMS1 tanks (Table D3-2) is high, TOC values for these tanks range from 1,900 μg/g to 24,600 μg/g. The average analytical TOC concentration for tank 241-S-106 was 2,090 μg/g.

Fluoride. The sample-based fluoride ion inventory estimate is about 6.5 times higher (6,450 kg) than in the HDW model (1,000 kg). The sample data is consistent with data for other SMMS1 samples (Table D3-2).

Iron. The Fe inventory for the engineering assessment is about a factor of two higher than the HDW model inventory. As noted in Table D3-2, most tanks containing SMMS1 contain higher inventories than predicted by the HDW model.

Aluminum. The aluminum value determined in this engineering assessment is about a factor of two lower than the HDW model inventory. As shown in Table D3-2, the aluminum concentrations for the four saltcake tanks are consistently about half that predicted by the HDW model. This is attributed to solubility assumptions in the model and the absence of sludge in the analytical results.

Strontium-90 and Cesium-137. The strontium and cesium inventories from the HDW model are higher than for the analytical-based results. This may be attributed to the absence of a sludge layer in the core sample.

Total Hydroxide. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valence of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997b).

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-S-106 was performed, and a best basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task. The following information was used in the evaluation:

- Analytical results for two, 1997 push-mode core samples
- Tank waste photographs
- The inventory estimate generated by the HDW model (Agnew et al. 1997b)
- An engineering evaluation that estimated average SMMS1 concentrations based on available sample results for S and U farm tanks containing SMMS1 waste.

Based on this evaluation, a best-basis inventory was developed for tank 241-S-106. The sampling-based inventory was chosen as the best basis for those analytes for which analytical values were available. The engineering inventory was calculated assuming a supernatant pool size of 201 kL (53 kgal). The remainder of the waste 1,612 kL (426 kgal) is SMMS1 saltcake. Although a bottom sludge layer of R/CWR waste was predicted by Agnew et al. (1997b) and Hanlon (1998), no R/CWR waste was observed in 1997 core samples. Results from similar S and U Farm tanks (SMMS1 template) were used to estimate analyte inventories where sample data was not available for tank 241-S-106. HDW model results were used if no sample based information was available.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, and so forth, have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997b). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result, if available.

The best-basis inventory estimate for tank 241-S-106 is presented in Tables D4-1 and D4-2. Mercury values were specified in Simpson (1998).

The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-106 (Effective December 31, 1997). (3 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	54,000	S	
Bi	334	S	
Ca	339	S/E	Based on average SMMS1 values.
Cl	9,610	S	
TIC as CO_3	95,600	S	
Cr	16,800	S	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-106 (Effective December 31, 1997). (3 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
F	6,450	S	
Fe	4,630	S	
Hg	23.3	E	Per change package #7 (Simpson 1998)
K	2,210	S	
La	0	E	No La expected in evaporator supernatants
Mn	173	S	
Na	6.24E+05	S	
Ni	81.3	S	
NO_2	88,100	S	
NO_3	1.05E+06	S	
OH_{TOTAL}	1.55E+05	C	
Pb	194	S	Upper-bound sample result "less than detect"
PO_4	63,300	S	Based on IC analysis
Si	1,330	S	
SO_4	23,000	S	Based on IC analysis
Sr	17.1	S	Upper-bound sample result "less than detect"

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-106 (Effective December 31, 1997). (3 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, E, or C)[1]	Comment
TOC	6,110	S	
U_{TOTAL}	961	S	Upper-bound sample result "less than detect"
Zr	19.9	S	Upper-bound sample result "less than detect"

Notes:

[1]S = Sample-based (See Appendix B)
M = Hanford defined waste model-based, Agnew et al. (1997b)
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	478	M	
^{14}C	58.4	M	
^{59}Ni	3.82	M	
^{60}Co	60.3	S	Upper-bound sample result "less than detect", solids only.
^{63}Ni	372	M	
^{79}Se	6.05	M	
^{90}Sr	41,800	S	Solids only
^{90}Y	41,800	S	Based on ^{90}Sr activity
^{93}Zr	29.6	M	
^{93m}Nb	21.8	M	
^{99}Tc	418	M	
^{106}Ru	0.00981	M	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{113m}Cd	149	M	
^{125}Sb	246	M	
^{126}Sn	9.15	M	
^{129}I	0.805	M	
^{134}Cs	2.92	M	
^{137}Cs	2.81E+05	S	Solids only
^{137m}Ba	2.66E+05	S	Based on 0.946 of ^{137}Cs activity
^{151}Sm	21,300	M	
^{152}Eu	5.34	M	
^{154}Eu	203	S	Upper-bound sample result "less than detect", solids only.
^{155}Eu	752	S	Upper-bound sample result "less than detect", solids only.
^{226}Ra	2.67 E-04	M	
^{227}Ac	0.00161	M	
^{228}Ra	0.0874	M	
^{229}Th	2.09E-03	M	
^{231}Pa	7.24E-03	M	
^{232}Th	6.03E-03	M	
^{232}U	0.0582	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{233}U	0.223	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{234}U	0.336	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{235}U	0.0140	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{236}U	0.00849	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{237}Np	1.64	M	
^{238}Pu	0.996	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{238}U	0.321	S/M	Based on ICP U Sample result ratioed to HDW estimates for U isotopes.
^{239}Pu	52.8	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{240}Pu	7.80	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{241}Am	19.4	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{241}Pu	59.3	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{242}Cm	0.0365	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{242}Pu	2.83E-04	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective December 31, 1997). (4 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{243}Am	5.86E-04	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{243}Cm	0.00329	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.
^{244}Cm	0.0368	S/M	Based on total alpha sample result ratioed to HDW estimates for alpha isotopes.

Notes:

[1]S = Sample-based (See Appendix B)
M = Hanford defined waste model-based, Agnew et al. (1997b)
E = Engineering assessment-based.

D5.0 APPENDIX D REFERENCES

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997a, *Waste Status and Transaction Record Summary (WSTRS Rev. 2)*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Baldwin, J. H., and R. H. Stephens, 1996, *Tank Characterization Report for Single-Shell Tank 241-U-109*, WHC-SD-WM-ER-609, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Brown, T. M., R. D. Cromar, J. L. Stroup, and R. T. Winward, 1997, *Tank Characterization Report for Single-Shell Tank 241-U-106*, HNF-SD-WM-ER-636, Rev. 0, Lockheed Martin Hanford Corp., Richland, Washington.

Eggers, R. F., R. H. Stephens, and T. T. Tran, 1996, *Tank Characterization Report for Single-Shell Tank S-102*, WHC-SD-WM-ER-611, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1998, *Waste Tank Summary Report for Month Ending November 30, 1997*, HNF-EP-0182-116, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

Hodgson, K. M., and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Lockheed Martin Hanford Corp., Richland, Washington.

Kruger, A. A., B. J. Morris, and L. J. Fergestrom, 1996, *Tank Characterization Report for Single-Shell Tank 241-S-101*, WHC-SD-WM-ER-613, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, R. A. Watrous, S. L. Lambert, D. E. Place, R. M. Orme, G. L. Borsheim, N. G. Colton, M. D. LeClair, R. T. Winward, and W. W. Schulz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corp., Richland, Washington.

Simpson, B. C., 1998, "Best Basis Inventory Change Package for Reconciliation of Mercury Values", Change package #7 (internal memorandum TA120-98-005 to S. W. Conmann, February 26), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989*, HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corp., Richland, Washington.

APPENDIX E

BIBLIOGRAPHY FOR TANK 241-S-106

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-S-106

Appendix E is a bibliography that supports the characterization of tank 241-S-106. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, modeling information, and processing occurrences associated with tank 241-S-106 and its respective waste types.

The references in this bibliography are separated into three categories containing references broken down into subgroups. These categories and their subgroups are listed below.

I. NON-ANALYTICAL DATA

- Ia. Models/Waste Type Inventories/Campaign Information
- Ib. Fill History/Waste Transfer Records
- Ic. Surveillance/Tank Configuration
- Id. Sample Planning/Tank Prioritization
- Ie. Data Quality Objectives/Customers of Characterization Data

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

- IIa. Sampling of tank 241-S-106
- IIb. Sampling of 242-S Evaporator Streams

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

- IIIa. Inventories using both Campaign and Analytical Information
- IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

The bibliography is broken down into the appropriate sections of material with an annotation at the end of each reference describing the information source. Most information listed below is available in the Lockheed Martin Hanford Corp. Tank Characterization and Safety Resource Center.

I. NON-ANALYTICAL DATA

Ia. Models/Waste Type Inventories/Campaign Information

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Contains single-shell tank fill history and primary campaign and waste Information to 1981.

Boldt, A. L., 1966, *Redox Chemical Flowsheet HHW No. 9*, ISO-335, Isochem, Inc., Richland, Washington.

- Contains compositions of material balance for REDOX process as well as a separations plan denoting process stream waste transfer to 200 Area waste tanks.

Crawley, D. T., 1960, *Redox Chemical Flowsheet HW-No. 6*, HW-66203, Hanford Atomic Products Operation, General Electric Company, Richland, Washington.

- Contains compositions of material balance for REDOX process as well as a separations plan denoting process stream waste before transfer to 200 Area waste tanks.

Jungfleisch, F. M., and B. C. Simpson, 1993, *Preliminary Estimation of the Waste Inventories in Hanford Tanks Through 1980*, WHC-SD-WM-TI-057, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- A model based on process knowledge and radioactive decay estimations using ORIGEN for different compositions of process waste streams assembled for total, solution, and solids compositions per tank. Assumptions about waste/waste types and solubility parameters and constraints are also given.

Merrill, E. T., and R. L. Stevenson, 1955, *REDOX Chemical Flowsheet HW No. 5*, HW-38684, Hanford Atomic Products Operation, General Electric Company, Richland, Washington.

- Contains compositions of material balance for REDOX process as well as a separations plan denoting process stream waste before transfer to 200 Area waste tanks.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Waste Status and Transaction Record Summary (WSTRS) Rev. 4*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains spreadsheets showing all available data on tank additions and transfers.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Contains single-shell tank fill history and primary campaign and waste information to 1981.

Ic. Surveillance/Tank Configuration

Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.

- Shows tank riser locations in relation to a tank aerial view and a description of risers and their contents.

Lipnicki, J., 1997, *Waste Tank Risers Available for Sampling*, HNF-SD-RE-TI-710, Rev. 4, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Assesses riser locations for each tank. Not all tanks are included or completed. Also includes an estimate of the risers available for sampling.

Tran, T. T., 1993, *Thermocouple Status Single-Shell & Double-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains riser and thermocouple information for Hanford Site waste tanks.

Id. Sample Planning/Tank Prioritization

Brown, T. M., S. J. Eberlein, J. W. Hunt, and L. J. Fergestrom, 1997, *Tank Characterization Technical Sampling Basis*, HNF-SD-WM-TA-164, Rev. 3, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Summarizes the technical basis for characterizing tank waste and assigns a priority number to each tank.

Bruthers, J. W., 1997, *Sampling Plan for Tank 241-S-106, Retained Gas Sample Deployment*, (external letter FDH9700120 to R. E. Bauer, Duke Engineering & Services, Inc., January 24), Pacific Northwest National Laboratory, Richland, Washington.

- Contains sampling and analysis requirements for retained gas samples in support of flammable gas issues.

DOE-RL, 1996, *Recommendation 93-5 Implementation Plan*, DOE/RL-94-0001, Rev. 1, U.S. Department of Energy Richland Operations, Richland, Washington.

- Describes tank issues and sampling requirements.

Buckley, L. L., 1997, *Push Mode Core Sampling and Analysis Plan for Tank 241-S-106*, HNF-SD-WM-TSAP-124, Rev. 0C, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains sampling and analysis requirements for tank 241-S-106 based on applicable data quality objectives .

Buckley, L. L., and W. D. Winkelman, 1996, *Tank 241-S-106 Tank Characterization Plan*, WHC-SD-WM-TP-389, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

- Contains sampling and analysis requirements for tank 241-S-106 for applicable data quality objectives.

Homi, C. S., 1996, *Vapor Sampling and Analysis Plan*, WHC-SD-WM-TP-335, Rev. 2A, Westinghouse Hanford Company, Richland, Washington.

- Vapor sampling and analysis procedure for 200 Area Tanks.

Winkelman, W. D., M. R. Adams, T. M. Brown, J. W. Hunt, D. J. McCain, L. S. Fergestrom, 1997, *Fiscal Year 1997-1998 Waste Information Requirements Document*, HNF-SD-WM-PLN-126, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains Tri-Party Agreement (Ecology et al. 1997) requirement-driven TWRS Characterization Program information.

Ie. Data Quality Objectives and Customers of Characterization Data

Cash, R. J., 1996, *Application of Flammable Gas Tank Safety Program Data Requirements for Core Sampling Analysis Developed through the Data Quality Objectives Process*, Rev. 2, (internal memorandum 79300-96-028 to S. J. Eberlein, July 12), Westinghouse Hanford Company, Richland, Washington.

- Contains flammable gas requirements for single-shell tanks.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Determines whether tanks are under safe operating conditions.

Meacham, J. E., D. L. Banning, M. R. Allen, and L. D. Muhlestein, 1997, *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue*, HNF-SD-WM-DQO-026, Rev. 0, Duke Engineering & Services, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains requirements for the organic solvents DQO.

Osborne, J. W., and L. L. Buckley, 1995, *Data Quality Objectives for Tank Hazardous Vapor Safety Screening*, WHC-SD-WM-DQO-002, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Contains requirements for addressing hazardous vapor issues.

Schreiber, R. D., 1997, *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements*, HNF-SD-WM-RD-060, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains requirements, methodology and logic for analyses to support organic complexant issue resolution.

Simpson, B. C., and D. J. McCain, 1997, *Historical Model Evaluation Data Requirements*, HNF-SD-WM-DQO-018, Rev. 2, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Provides data needs for evaluating the Los Alamos National Laboratory model for estimating tank waste compositions.

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

IIa. Sampling of Tank 241-S-106

Caprio, G. S., 1997, *Vapor and Gas Sampling of Single-Shell Tank 241-S-106 Using the In-Situ Vapor Sampling System*, HNF-SD-WM-RPT-246, Rev. 0, SGN Eurisys Services Corp. for Fluor Daniel Hanford Inc., Richland, Washington.

- Contains sampling and analysis requirements for tank 241-S-106 vapor gas sampling.

Esch, R. A., 1997, *Tank 241-S-106, Cores 183, 184 and 187 Analytical Results for the Final Report*, HNF-SD-WM-DP-242, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains results for February/March 1997 core sampling event analyses.

Mahoney, L. A., Z. I. Antoniak, and J. M. Bates, 1997, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 242-U-103, S-106, BY-101, and BY-109*, PNNL-11777, Pacific Northwest National Laboratory, Richland, Washington.

- Contains retained gas sample results for tank 241-S-106.

Evans, J. C., K. H. Pool, B. L. Thomas, K. B. Olson, J. S. Fruchter, and K. L. Silvers, 1997, *Headspace Vapor Characterization of Hanford Tank 241-S-106: Results from Samples Collected on 06/13/96*, PNNL-11260, Pacific Northwest National Laboratory, Richland, Washington.

- Contains vapor sample results obtained in June 1996.

IIb. Sampling of 242 S-Evaporator Waste Streams

- In addition to current core sample and vapor sample analyses, the following memoranda and letters may provide insight as to the composition of the saltcake waste type expected to be in tank 241-S-106.

Babad, H., and J. S. Buckingham, 1974, *Analysis of Solidified Salt Wastes and Associated Mother Liquors*, (internal letter to G. S. Barney, September 5), Atlantic Richfield Hanford Company, Richland, Washington.

Buckingham, J. S., 1974, *Analyses of Samples from 242-S Slurry Receiving Tanks*, (internal letter to M. H. Campbell, March 13), Atlantic Richfield Hanford Company, Richland, Washington.

Cain, R. J., 1974, *Dry Saltcake Composition,* (internal letter to R. E. Vander Cook, October 18), Atlantic Richfield Hanford Company, Richland, Washington.

Christensen, W. R., 1974, *Sludge Sampling Status*, (internal letter to R. L. Walser, August 27), Atlantic Richfield Hanford Company, Richland, Washington.

Christensen, W. R., 1974, *Sludge Sampling Status*, (internal letter to R. L. Walser, September 11), Atlantic Richfield Hanford Company, Richland, Washington.

Geier, R. G., 1976, *Estimated Hanford Liquid Waste Chemical Inventory as of June 30, 1976*, ARCH-CD-758, Atlantic Richfield Hanford Company, Richland, Washington.

Horton, J. E., 1975, *Analysis of Salt and Liquid Sample From 106-S Tank,* (internal letter to W. R. Christensen, July 23), Atlantic Richfield Hanford Company, Richland, Washington.

Horton, J. E., 1974, *Achievement Report*, Draft Report, Atlantic Richfield Hanford Company, Richland, Washington.

Horton, J. S., and J. S. Buckingham, 1974, *Analyses of Salt Samples from 242-S Evaporator Slurry Receiving Tanks 105-S, 106-S, and 111-S*, (internal letter to N. L. Harms, August 23), Atlantic Richfield Hanford Company, Richland, Washington.

Jurgensmeier, C. A., 1991, *Results of Single-Shell/Double-Shell Data Research*, (internal letter 28110-PCL91-046 to H. Babad, May 30), Westinghouse Hanford Company, Richland, Washington.

Pitkoff, C., 1991, *Sample 106-S Tank*, (process memorandum 91-139 to shift manager, October 4), Westinghouse Hanford Company, Richland, Washington.

Puryear, D. A., 1971, *Characterization of S, U, and SX Waste Tanks*," (internal letter 00347 to J. O. Skolrud, September 21), Atlantic Richfield Hanford Company, Richland, Washington.

Reynolds, D. A., 1982, *242-S Evaporator Crystallizer Third Partial Neutralization Campaign*, RHO-CD-1515, Rockwell Hanford Operations, Richland, Washington.

Sant, W. H., 1974, *242-S Feed Samples, Number T-738, Sample Point 106-S*, (internal letter to R. L. Walser, January 21), Atlantic Richfield Hanford Company, Richland, Washington.

Sant, W. H., 1973, *242-S Feed Samples Number T-9494*, (internal letter to R. L. Walser, December 18), Atlantic Richfield Hanford Company, Richland, Washington.

Sant, W. H., 1973, *242-S Feed Samples Number T-9492*, (internal letter to R. L. Walser, December 7), Atlantic Richfield Hanford Company, Richland, Washington.

Sant, W. H., 1973, *242-S Feed Samples Number T-9491*, (internal letter to R. L. Walser, December 7), Atlantic Richfield Hanford Company, Richland, Washington.

Sant, W. H., 1972, *Analysis of Tank Farm Samples T-5497*, (internal letter to C. M. Walker, August 16), Atlantic Richfield Hanford Company, Richland, Washington.

WHC, 1992, *Sample Status Report for R-1131, 9/9/92*, Westinghouse Hanford Company, Richland, Washington.

Wheeler, R. E., 1974, *Dry Saltcake Composition*, (internal letter to R. E. Vander Cook, October 18), Atlantic Richfield Hanford Company, Richland, Washington.

Wheeler, R.E., 1974, *Analysis of Tank Farm Samples, Sample T-5469, 106-S*, (internal letter to R. L. Walser, October 14). Atlantic Richfield Hanford Company, Richland, Washington.

Wheeler, R.E., 1974, *Analysis of Tank Farm Samples, Sample T-8035, 106-S*, (internal letter to R. L. Walser, December 16) Atlantic Richfield Hanford Company, Richland, Washington.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories from Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains waste type summaries and primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids.

Allen, G. K., 1976, *Estimated Inventory of Chemicals Added to Underground Waste Tanks, 1944 - 1975*, ARH-CD-601B, Atlantic Richfield Hanford Company, Richland, Washington.

- Contains major components for waste types, and some assumptions. Purchase records are used to estimate chemical inventories.

Allen, G. K., 1975, *Hanford Liquid Waste Inventory As Of September 30, 1974*, ARH-CD-229, Atlantic Richfield Hanford Company, Richland, Washington.

- Contains major components for waste types, and some assumptions.

Ewer, K. L., J. W. Funk, R. G. Hale, G. A. Lisle, C. V. Salois and M. R. Umphrey, 1997, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 Areas*, HNF-SD-WM-ER-352, Rev. 1, Fluor Daniel Northwest, Inc. for Fluor Daniel Hanford Inc., Richland, Washington.

- Contains summary information from the supporting document as well as in-tank photograph collages and the solid composite inventory estimates.

Schmittroth, F. A., 1995, *Inventories for Low-Level Tank Waste*, WHC-SD-WM-RPT-164, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Document contains tank inventory information.

IIIb. Compendium of Data from Other Physical and Chemical Sources

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Supporting Document for the Historical Tank Content Estimate for S-Tank Farm*, HNF-SD-WM-ER-323, Rev. 1, Fluor Daniel Northwest, Inc. for Fluor Daniel Hanford Inc., Richland, Washington.

- Contains historical data and solid inventory estimates. The appendices contain the following information: Appendix C - Level History AutoCAD sketch; Appendix D - Temperature Graphs; Appendix E - Surface Level Graph; Appendix F - Riser Configuration Drawing and Table; Appendix G - In-Tank Photos; and Appendix H - Tank Layer Model Bar Chart and Spreadsheet.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1995, *Tank Waste Source Term Inventory Validation, Vol I & II*, WHC-SD-WM-ER-400, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains a quick reference to sampling information in spreadsheet or graphical form for 23 chemicals and 11 radionuclides for all the tanks.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending October 31, 1997*, HNF-EP-0182-115, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains a monthly summary of the following: fill volumes, Watch List tanks, occurrences, integrity information, equipment readings, equipment status, tank location, and other miscellaneous tank information.

Husa, E. I., 1993, *Hanford Site Waste Storage Tank Information Notebook*, WHC-EP-0625, Westinghouse Hanford Company, Richland, Washington.

- Contains in-tank photographs and summaries on the tank description, leak detection system, and tank status.

Husa, E. I., 1995, *Hanford Waste Tank Preliminary Dryness Evaluation*, WHC-SD-WM-TI-703, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Assesses relative dryness between tanks.

Remund, K. M., and B. C. Simpson, 1996, *Hanford Waste Tank Grouping Study*, PNNL-11433, Pacific Northwest National Laboratory, Richland, Washington.

- Document contains a statistical evaluation to group tanks into classes with similar waste properties.

Shelton, L. W., 1996, *Chemical and Radionuclide Inventory for Single- and Double-Shell Tanks*, (internal memorandum 74A20-96-30 to D. J. Washenfelder, February 28), Westinghouse Hanford Company, Richland, Washington.

- Contains a tank inventory estimate based on analytical information.

Van Vleet, R. J., 1993, *Radionuclide and Chemical Inventories*, WHC-SD-WM-TI-565, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains tank inventory information.

Wilkins, N. E., 1996, *Flammable Gas Data Review for Tanks 241-S-102 and 241-S-106*, (internal memorandum 74A10-96-130 to J. H. Wicks, October 10), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford Inc., Richland, Washington.

- Includes flammable gas data review for tank 241-S-106.

Tank Characterization Data Base, Internet at http://twins.pnl.gov:8001/htbin/TCD/main.html

- Contains analytical data for each of the 177 Hanford Site waste tanks.

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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
ONSITE					
Department of Energy - Richland Operations					
J. F. Thompson	S7-54	X			
W. S. Liou	S7-54	X			
J. A. Poppiti	S7-54	X			
DE&S Hanford, Inc.					
R. J. Cash	S7-14	X			
W. L. Cowley	R1-49	X			
G. D. Johnson	S7-14	X			
J. E. Meacham	S7-14	X			
Fluor Daniel Northwest					
E. D. Johnson	S2-47	X			
Lockheed Martin Hanford, Corp.					
J. G. Burton	S7-21	X			
J. W. Cammann	R2-11	X			
J. G. Field	R2-12	X			
W. E. Ross	S7-84	X			
L. M. Sasaki	R2-12	X			
B. C. Simpson	R2-12	X			
R. R. Thompson	R2-12	X			
ERC (Environmental Resource Center)	R1-51	X			
T.C.S.R.C.	R1-10	5			
Lockheed Martin Services, Inc.					
B. G. Lauzon	R1-08	X			
Central Files	B1-07	X			
EDMC	H6-08	X			
Numatec Hanford Corporation					
J. S. Garfield	H5-49	X			
D. L. Herting	T6-07	X			
J. S. Hertzel	H5-61	X			
D. L. Lamberd	H5-61	X			
Pacific Northwest National Laboratory					
A. F. Noonan	K9-91	X			